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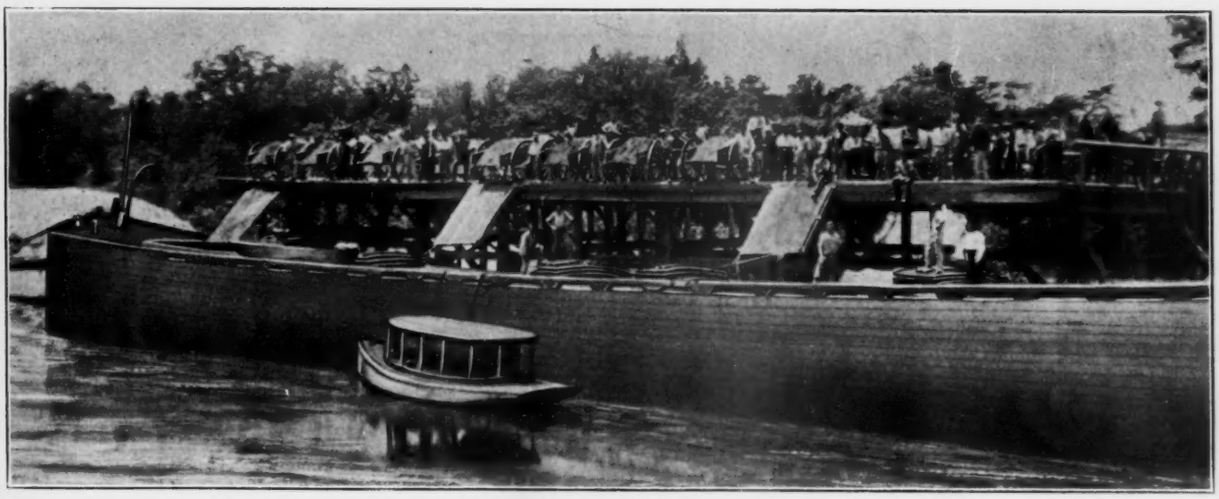

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THE FOUNDRY

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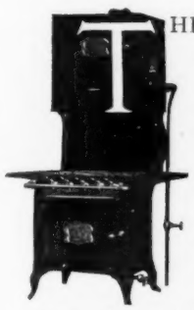
MATCH-PLATES FOR STOVE CASTINGS

Description of the method of molding stove plate by the use of hinged match-plates and flasks --- Economies effected in the molding cost



THE great economies that can be effected in the molding cost of stove plate by the use of the hinged match-plate has been conclusively demonstrated by the Michigan Stove Co., Detroit, where this method of molding has been followed for more than a year. One of the foundries operated by this concern, built several years ago, and which is a model plant of its kind, is devoted entirely to molding machine and match-plate work. A comparison of the cost of production in this shop with the firm's other foundry, where stove plate is made in the "old way," shows the tremendous saving in molding cost that can be effected by the use of these labor saving appliances. This shop alone, in which only 25 molders and handymen are employed, was the means of reducing the molding cost of the two foundries, employing about 300 molders, approximately 4 per cent. No allowance has been made for the investment in machines, match-plates, flasks and other equipment during the year, which, if otherwise credited, would materially increase this percentage.

The hinged aluminum match-plate is by no means a novelty in foundry work, but the credit for its development to the high state of perfection which it has attained in the plant of the Michigan Stove Co., Detroit, is due to W. J. Keep, works superintendent. The

FIG. 1—THREE FLOORS OF MOLDS MADE IN ONE DAY BY THREE OPERATORS ON SQUEEZERS EQUIPPED WITH HINGED MATCH-PLATES

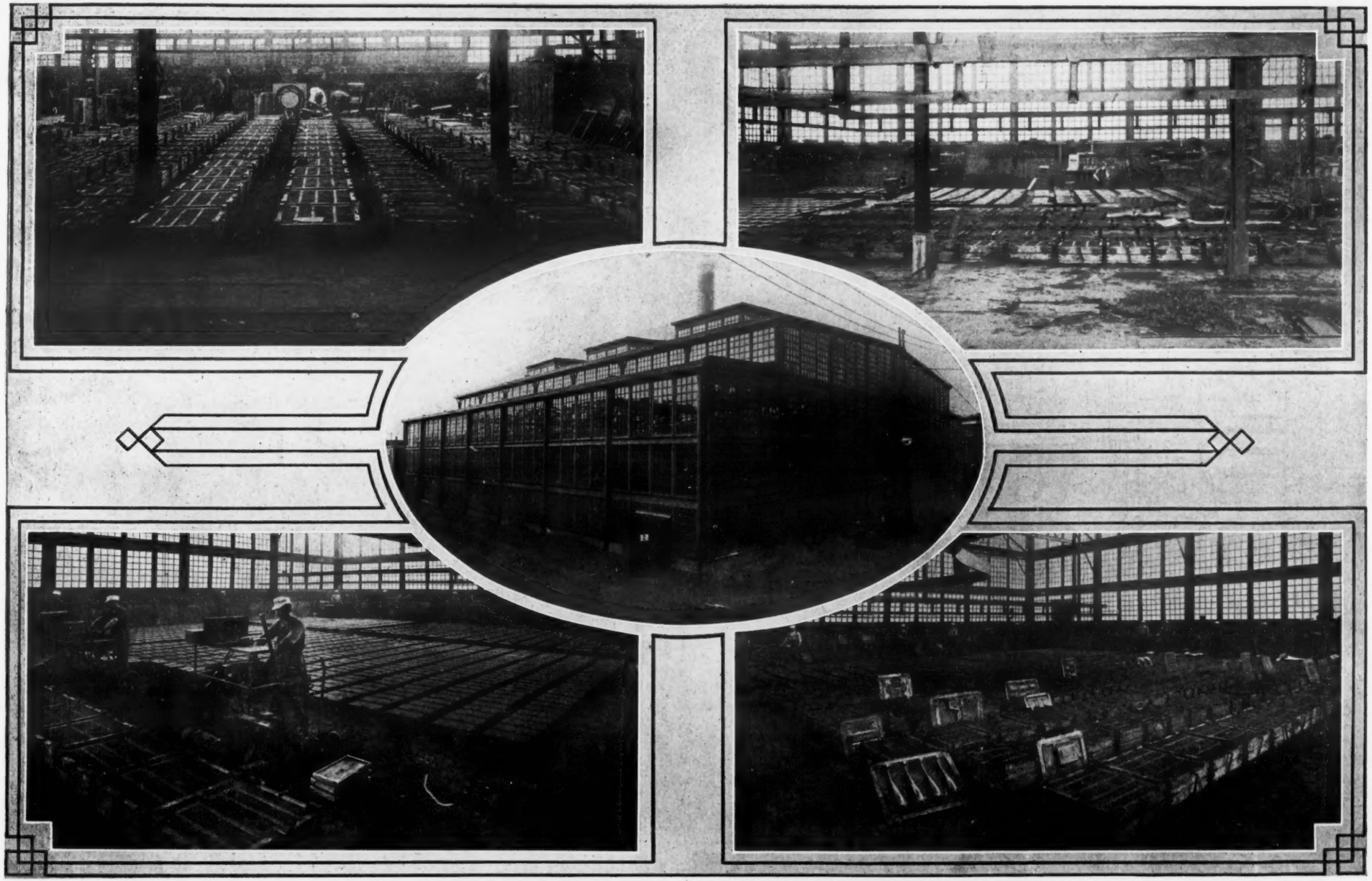


FIG. 2—FLOOR WORK MADE IN HINGED FLASKS AND HINGED MATCH-PLATES. THE FLOORS AVERAGE FROM 32 TO 44 MOLDS

FIG. 3—FLOORS OF STOVE LIDS MADE ON SQUEEZERS WITH HINGED MATCH-PLATES

FIG. 4—THE MICHIGAN STOVE CO.'S NEW FOUNDRY

FIG. 5—ANOTHER VIEW OF THE FOUNDRY, SHOWING FLOOR AND BENCH WORK

FIG. 6—FLOOR WORK, SHOWING THE HINGED MATCH-PLATES USED

metal from which the match-plates are cast, is the mixture in use in several shops, consisting of aluminum, two parts and zinc, one part. The use of the adjustable frame for molding the match-plates is a distinct improvement in this line of work, and the casting of the metal around the hinges has greatly reduced the cost of making these plates. Many novel features have also been introduced in preparing the patterns for the match-plate molds to insure the proper draft, and templates are employed wherever possible to rapidly and accurately fit hinges to the flasks. The use of the hinged match-plates with parts, is so constructed that it is not necessary to lift out the cope hinge member when removing a match-plate, which effects a great saving of time, particularly on floor work. By the use of the hinged match-plates and flasks, the number of operations required in making molds, both on the bench and on the floor, has been materially reduced. On bench work the time has been practically reduced one-half, and on floor work about one-third. The number of operations required for making a mold on the bench, with the hinged match-plate and squeezer, has been reduced to 33, as compared with that the castings are more uniform in weight and section, averages 12 per cent, and with a large melt this in itself is sufficient to pay handsome profits on the equipment investment. The molding machines used in this foundry consist of seven of the Modern type, as well as one squeezer, installed by the Arcade Mfg. Co., Freeport, Ill., and 15 Farwell squeezers built by the Adams Co., Dubuque, Ia.

Molds Made on Squeezers.

Three floors of molds put up by three men in one day, operating three Farwell squeezers, are shown at the left, Fig. 1.

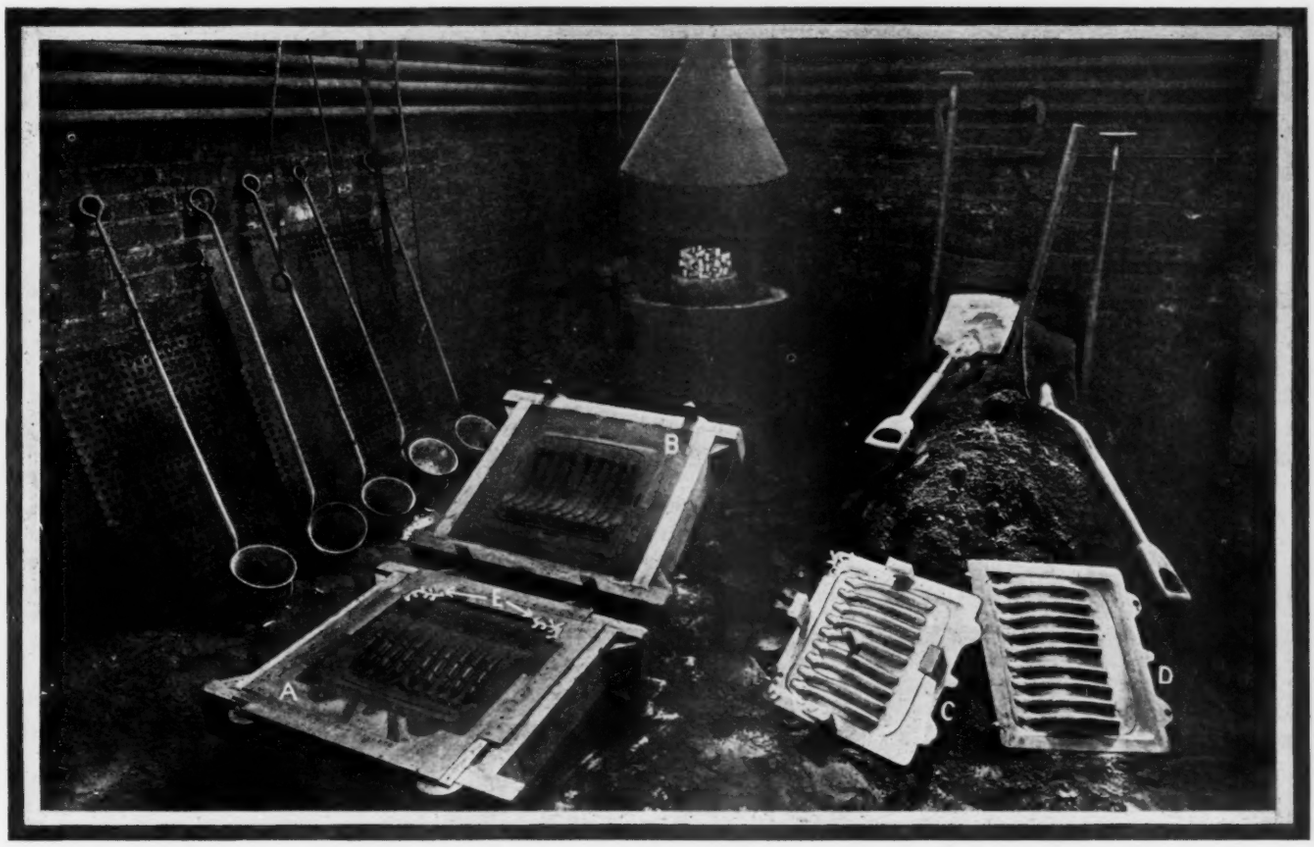


FIG. 7—THE MATCH-PLATE MOLDING DEPARTMENT. THE DRAG AND COPE HALVES OF THE MOLD ARE SHOWN AT *A* AND *B*, RESPECTIVELY. THE MATCH-PLATE FRAME IS IN POSITION ON THE DRAG

squeezers also involved difficulties which have been satisfactorily overcome.

When applying the hinged match-plate to floor work, it was decided that no flask would be made so large that it could not be conveniently handled by one man, and guided by previous experience, a division of the work was made into three classes. Small work is made in snap flasks, 1 inch thick, medium work in 1½-inch flasks and large work in 2-inch flasks. The lines of division separating light, medium and heavy work are closely defined, and it is not difficult to decide upon the type of flask necessary, the size of the match-plate being known.

The roll-up hinge, which is in three

52 by the hand method of molding, and the time required for making a mold in a flask, 12 x 21 inches, has been reduced from 4 minutes and 25 seconds to 1 minute and 30 seconds. Furthermore, a molder working leisurely made a mold in this flask by the squeezer-match-plate process in 2 minutes and 41 seconds.

Floor Work.

On floor work the number of operations in making a mold has been reduced from 65 to 52 by the hinged match-plates and flasks, and the time of making a certain large mold is now 10 minutes as against 18 minutes the "old way." The saving of metal, owing to the fact

The patterns of castings for gas ranges used on these squeezers are on hinged match-plates, and the output of one man averages from 175 to 200 molds daily. At the right is shown a floor of gas stove legs consisting of 32 molds. The match-plate is shown between the rows of molds, the patterns of four legs being on one plate. The molds are stepped-off on the floor, and this large output represents one man's work with no other equipment than hinged match-plates and flasks. This day's production is all the more wonderful when it is considered that all of the patterns have been printed-back, which entails several additional movements and considerable more labor than when the patterns are not returned

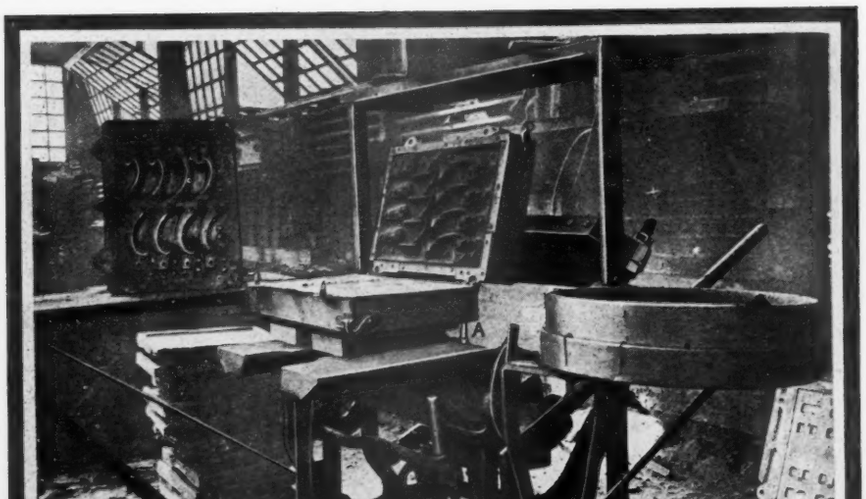


FIG. 8—MOLD MADE ON A SQUEEZER. ONE OF THE TWO SUPPORTS FOR THE BACK END OF THE DRAG FLASK IS SHOWN AT *A*

to the molds. In the foreground is a finished mold containing four stove legs with the match-plate raised prior to lifting it out of the flask and closing the mold. The match-plate of the four gas stove legs in Fig. 1 is also shown at *G*, Fig. 16. It is 26 x 29 inches, while the match-plate of the four stove legs in the foreground, Fig. 1, is also illustrated at *F*, Fig. 16, and is 13 x 27 inches.

The Foundry.

The foundry, exterior view of which is shown in Fig. 4, was described in THE FOUNDRY, December, 1907, page 174. The walls consist of a practically unbroken series of windows, insuring ample light on the darkest days, and the roof has been constructed to insure excellent light from above. The building is 128 feet square, approximately 50 feet to the top of the monitors, 40 feet to the highest point in the roof proper, and 30 feet to the roof at the sides. The foundations are of concrete and the walls, 6 feet high, are of brick 12 inches thick, while the balance of the construction is of steel with a roof of 2½-inch matched pine. The building is so nearly fire-proof that it has not been considered necessary to install sprinklers. The height of 30 feet at the sides of the building is to allow a deck to be erected at some future time on the line of the top of the first row of windows. The foundry floor is brick laid in cement. One corner, 18 x 60 feet, is used for a core room. The cupola is located in the center of the foundry, and an overhead tramrail system has been installed to convey the metal in bull ladles to the various floors, and from these ladles the hand ladles are filled. One of the bull ladles suspended from the trolley is shown in Fig. 1, and a section of the overhead tramrail system is clearly illustrated in Fig. 5.

Additional interior views of the foundry are shown in Figs. 2, 3, 5 and 6. The daily output of two molders and three handymen, consisting of five floors, only four of which can be clearly seen, is shown in Fig. 2. One man produced 44 molds and the output of the others ranged down to 32 molds. On this floor, hinged match-plates were used exclusively and the size of some of these plates is shown in Fig. 6. Several floors of stove legs made with match-plates on Farwell squeezers are illustrated in Fig. 3, while Fig. 5 is another view of the foundry showing both floor and bench work ready to pour.

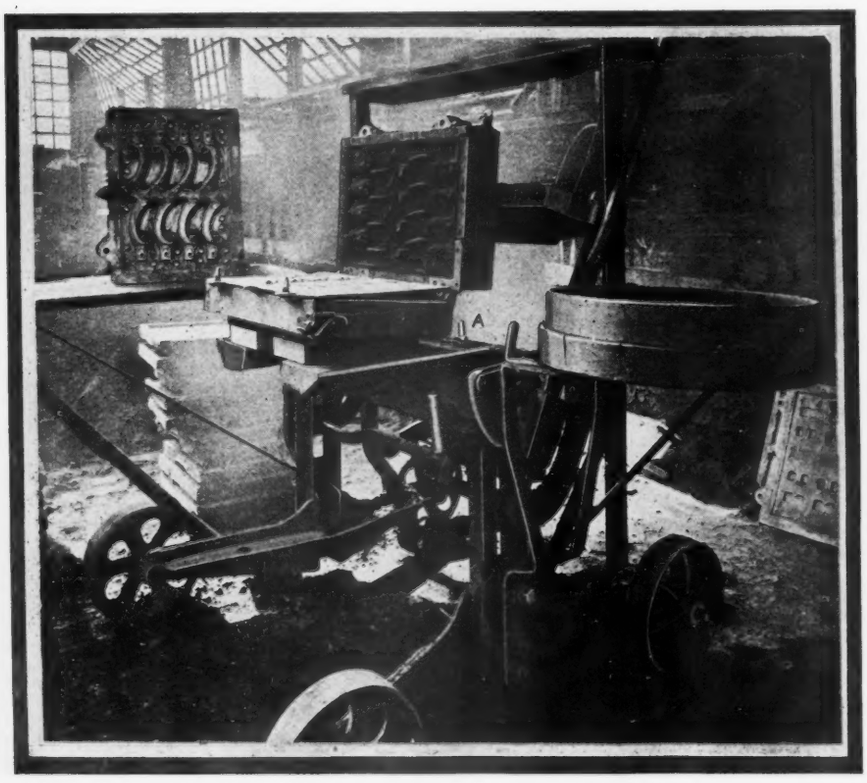


FIG. 9—DRAG TILTED AS A RESULT OF NOT BEING SUPPORTED BY PINS, *A*

Match-Plate Molding Department.

For making the match-plates, a special room has been partitioned off in the foundry, which is equipped with a natural draft coke furnace for melting the aluminum-zinc mixture, which consists of two parts of aluminum and one part of zinc. The metal is melted in crucibles, as shown in Fig. 7, and forced draft is provided by a small blower, which is only utilized when the stack, which is small, does not furnish sufficient draft for melting the metal. The drag and cope of a match-plate mold are shown at *A* and *B*, respectively, and the match-plate before the sprues and risers were cut off, and immediately after it was shaken out of the sand, is at *C*, while *D* is the finished match-plate with the sprues and risers removed.

This plate contains the patterns of nine stove lifters.

Adjustable Frame for Molding Match-Plates.

The adjustable frame, from which match-plates of any size, from the smallest to the largest in use in the foundry, can be made, is shown in position on the drag. This frame is ¼ inch thick and separates the cope and the drag ¼ inch, insuring a plate of this uniform thickness throughout. The two malleable iron hinges are shown at *E* held in the frame by projections to insure their accurate location, and to prevent their possible movement out of position. These projections on the hinges are ground off after the match-plate has been cast. The hinges have dovetail-like projections on their inner sides around which the aluminum-zinc mixture flows, firmly holding them in place. Casting these hinges into the plate insures their accurate location, and furthermore eliminates considerable machine work and the fitting of the hinges to the plates with rivets.

The adjustable frame for molding hinged match-plates for 2-inch floor flasks is shown in Fig. 27. The frame is made of tool steel with adjustments on the four sides graduated to 1-inch spaces, for making match-plates up to 36 inches wide and 43 inches long. This view shows the frame on a mold with the location of gates and risers indicated, ready to receive the metal after the cope is closed over. The two malleable iron hinges are in position, their projections extending into recesses in the adjustable frame. It will be noted that this match-plate is to be 21 x 32 inches, the arrows indicating the size to which the frame has been set. An adjustable frame for molding match-plates for bench work is shown in Fig. 28, and is similar in construction to the larger frame for match-plates for 2-inch floor flasks.

The preparation of the patterns for the match-plate mold is an essential feature of this process and entails careful work on the part of the patternmaker. As many white metal patterns as are required for the plate are cast, and if the patterns are small and stiff enough to sustain themselves, they are arranged on a follow-board with wooden wedges under their edges, which are glued or nailed to the follow-board. Thin wire nails are driven around and bent over the patterns, to prevent them from moving until the molder is ready to make the mold, when he bends them back so as to free the pattern.

Patterns of sufficient size to require supporting on their under surfaces are backed with plaster. Two white metal patterns backed in this way, on a follow-board, are shown in Fig. 20. To back

FIG. 10—SQUEEZER, SHOWING DRAG FLASK SUPPORTING PINS, *A*

the patterns with plaster, they are placed pattern face up on a face plate and are leveled. Sand is then placed around the edges and tucked under, making an exact parting, boards being set on edge making a box around the pattern. All the joints are closed with clay and a mixture of plaster and parting sand is then poured onto the pattern, which has been brushed with lard or machine oil to prevent the plaster from sticking to the pattern. The parting sand is used only to save plaster.

When all of the patterns that are required for the match-plate are backed with plaster, they are arranged on the

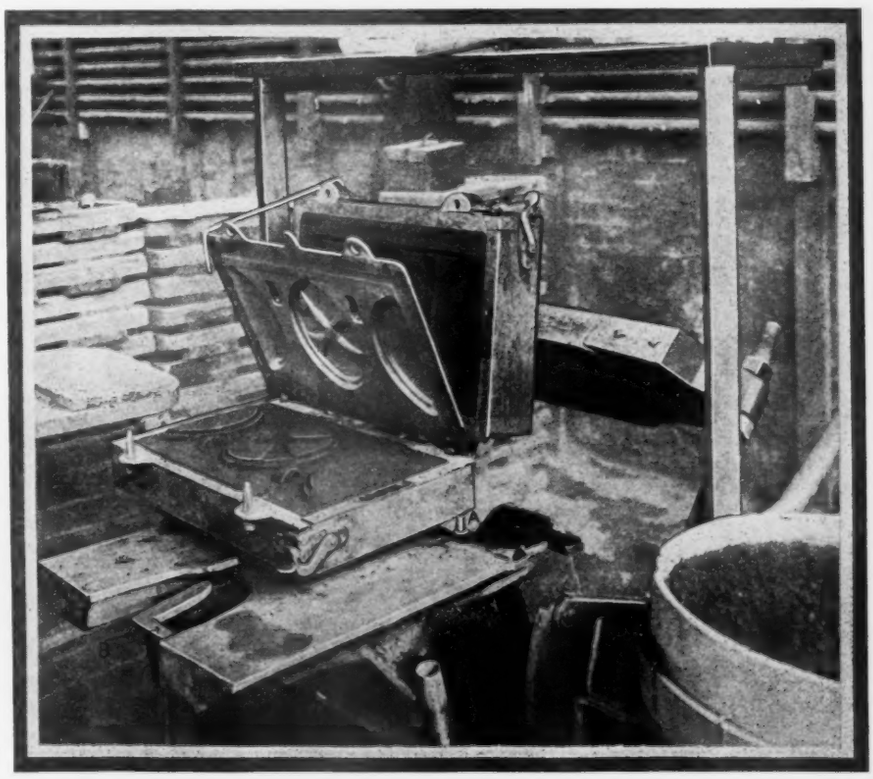


FIG. 11—MATCH-PLATE RAISED WHILE THE OPERATOR DUSTS ON THE FACING

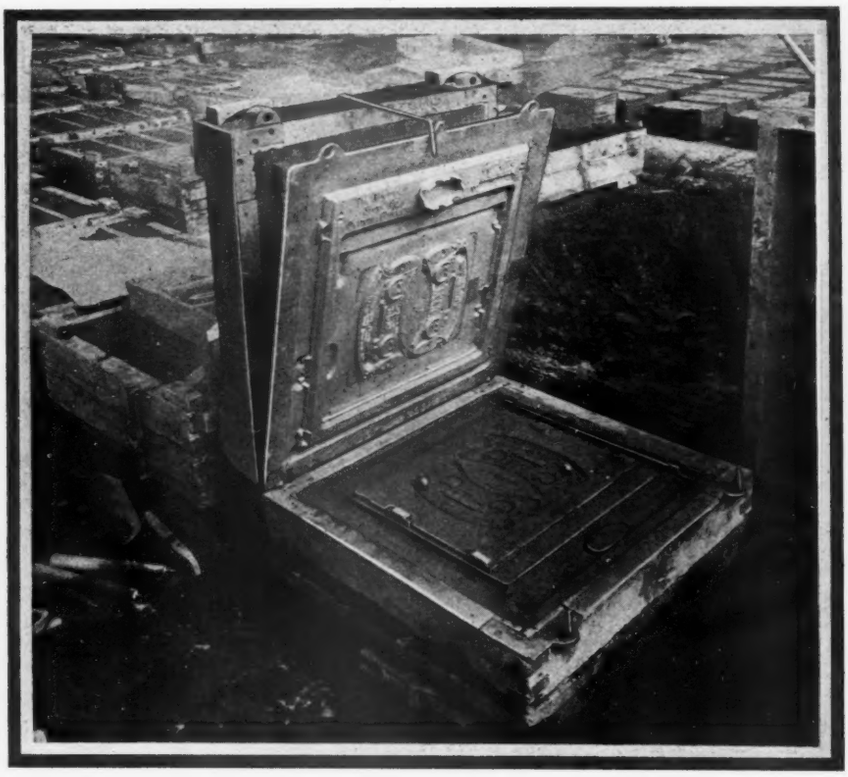


FIG. 12—FLOOR MOLD SHOWING HINGED MATCH-PLATE SUPPORTED WHILE THE OPERATOR DUSTS FACING ON THE DRAG BEFORE PRINTING-BACK

follow-board as required for the match-plate, face down, and in such position that all parts will allow the cope of the mold, as well as the match plate to roll up without any under draft. The patterns are made with this end in view.

After the patterns are located, a temporary wooden strip is placed on one side of the follow-board, as shown in Fig. 20, whose upper surface represents the edge of the flask or parting line. A space of 1 inch from the edge of the pattern is allowed for sand, and to this the thickness of the flask is added as well as ¼ inch additional to reach the center of the match-plate hinges. A line is then drawn on the wooden strip representing this axis of the match-plate hinges.

FIG. 13—FLOOR MOLD BEFORE CLOSING. THE MATCH-PLATE HAS BEEN LIFTED OUT

Three-Pointed Trammel.

A three-pointed trammel, shown in Fig. 23, as well as in Fig. 20, is then used, the double points being set down on the line on the wooden strip, and the rod which carries the single point is then moved out until the point is set at the bottom of a draft which is to be tested. The single point is then raised, turning on the double points as an axis, to ascertain whether it strikes the pattern. If it does, the pattern must be cut away, and the other side must be changed to correspond. The trammel point is moved about the pattern until every doubtful draft is tested. It is sometimes necessary to wedge up or lower one side of the plaster back, but the surface of the wooden strip is raised or lowered until all parts give a free lift. Wooden strips are then placed on all sides of the follow-board, the hinged side being marked for the guidance of the molder. If it is impossible to board up old patterns to allow a roll-up of both the cope and the match-plate, such patterns are not adapted to match-plate work, but new patterns can always be made suitable for the roll-up match-plate process.

Match-Plates for Stove Work.

That practically all of the patterns required in the production of stove plate can be mounted on match-plates is shown by the varied assortment of patterns on plates in Figs. 16 and 17. The match-plates in Fig. 16 are as follows: *A*, gas stove top, 26 x 28 inches, with a deadhead in the center containing four stove leg corners; *B*, four gas stove burners on one plate, 13 x 22 inches; *C*, heater door frame, two on one plate, 21 x 30 inches; *D*, gas heater door, 14 x 18 inches; *E*, gas stove top, 25 x 26 inches, with two deadhead lighter plates in the center; *F*, four stove legs on one plate, 13 x 27 inches; *G*, four gas stove legs on one plate, 26 x 29 inches; *H*, two gas range oven doors, 21 x 30 inches, with deadheads in each; *I*, three-burner gas stove hot plate, 16 x 35 inches; *J*, right and left sides of wood cook stove, 23 x 35 inches; *K*, two oven doors on one plate, 23 x 32 inches; *L*, cope side of gas stove top, drag of which is shown at *E*, Fig. 16—this view clearly shows the screws by which the deadhead is fastened to the match-plate; *M*, two stove fronts on one plate, 26 x 33 inches. That the malleable iron hinges are firmly imbedded in the aluminum-

zinc plates is shown by these illustrations. The bright surfaces on some of the match-plates are where the gates and risers have been ground off.

Shrinkage Allowance.

The total shrinkage allowance, from the wood pattern to the iron casting is 5-16 inch per foot. The shrinkage of the white metal is 0.04 inch; aluminum-zinc mixture, 0.0146 inch, and the shrinkage of the iron casting is 0.125 inch. The total shrinkage is, therefore, 0.311 inch, equivalent to practically 5-16 inch. As compared with the aluminum match-plates, cast iron match-plates are 2.6 times as heavy. An aluminum match-plate, for instance, of a gas stove top, weighs 36 pounds, whereas, cast in iron, this plate weighs 94 pounds. Furthermore, test bars show that the aluminum-zinc mixture has practically the same strength as cast iron, will not bend, and in addition is free from corrosion, from which cast iron patterns suffer severely in the foundry.

The Roll-Up Hinge.

The construction and operation of the roll-up hinge, which is in three parts, one being attached to the drag flask, the second to the match-plate and the third to the cope flask, is shown in Fig. 19. At *A* is a side elevation of one of the hinges in a snap flask after squeezing the sand, with the match-plate in position. This shows a sectional view of the flask and the sand. In *B* the cope is rolled up, and at the point *C* a support is necessary for the back of the drag flask to prevent it from tilting, as shown in Fig. 9. In this view the match-plate is still in the drag; at *D* the match-plate has been lifted up and out of the hinge, and is being removed without the necessity of lifting off the cope hinge; *E* is the mold closed with the match-plate removed, the supporting pins at the back of the drag flask no longer being necessary, and after the removal of the snap flask the mold is lifted from the machine to the floor ready to receive the metal; *L* shows the cope members of a pair of hinges attached to the cope flask, and *F* the drag members of a pair of hinges screwed to the drag flask.

Provisions for Variation in Metal Thickness.

At *G* are raised projections cast in the cope and drag hinges, 3-64 inch thick, giving a total thickness of 3-32 inch. The match-plate bears on these four projections at the four corners, and if the metal thickness of the casting is too great, these projections are filed down, thereby reducing the metal thickness as desired. As previously stated, this gives a variation of 3-32 inch, which is more than ample to correct the metal thickness of any casting. To provide for the shrinkage of the match-plate, and to obviate the necessity of fitting one of the drag hinges to the plate, it will be noted that the seat *H* in the drag hinge, in which a projection in the match-plate hinge rotates, is wider than the seat in the hinge member on the other side. This allows for ⅛ inch

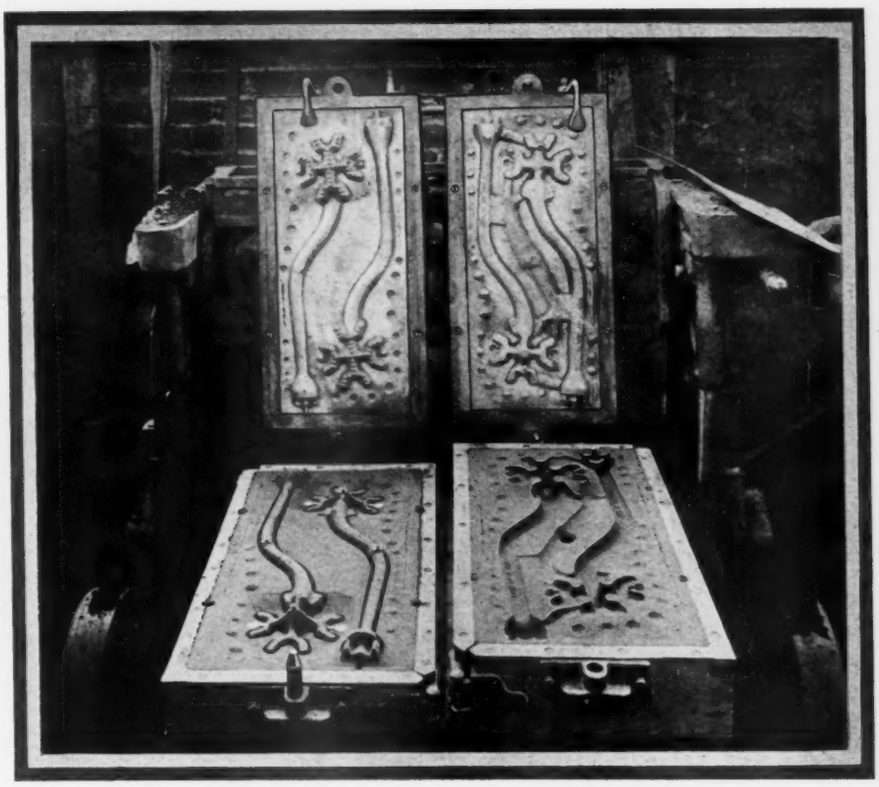


FIG. 14—DRAG AND COPE HALVES OF THE MOLD OF A PAIR OF GAS STOVE BURNERS, SHOWING CHAPLETS IN THE CORES

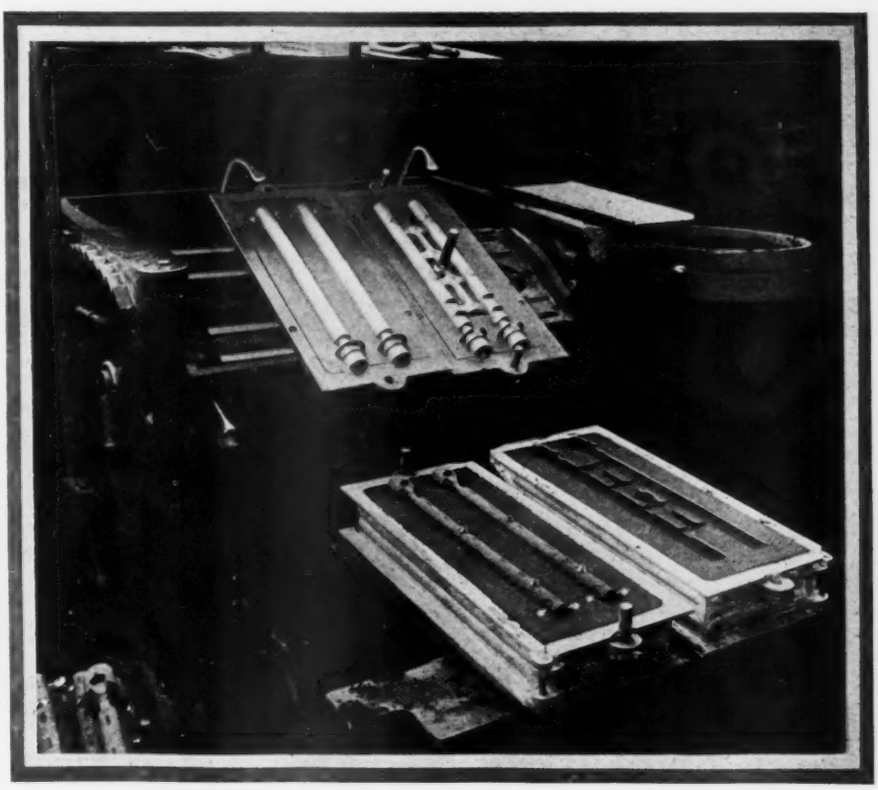


FIG. 15—CHAPLETS IN CORES OF A PAIR OF OVEN BURNERS

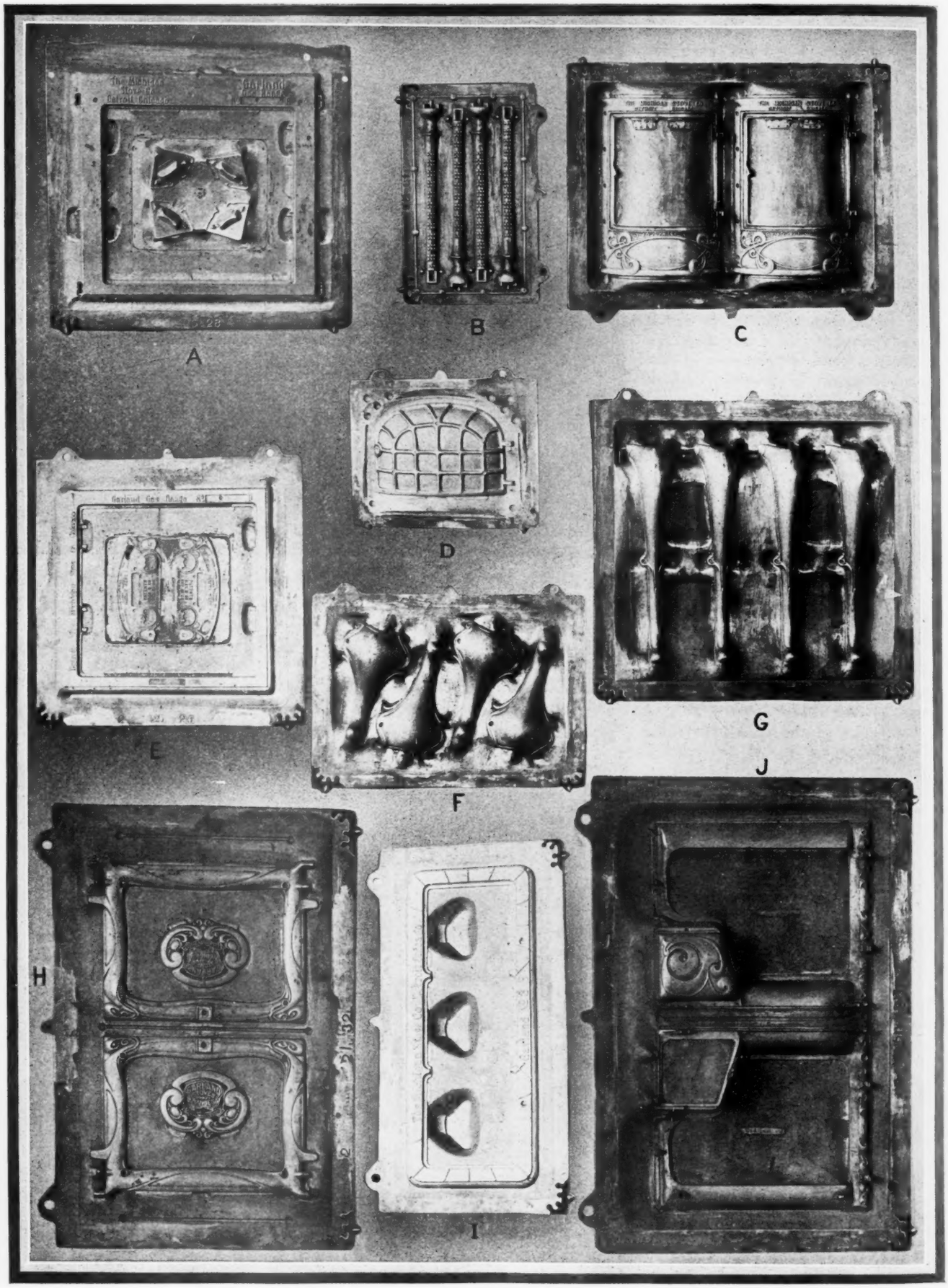


FIG. 16—HINGED ALUMINUM MATCH-PLATES FOR MOLDING STOVE PLATE

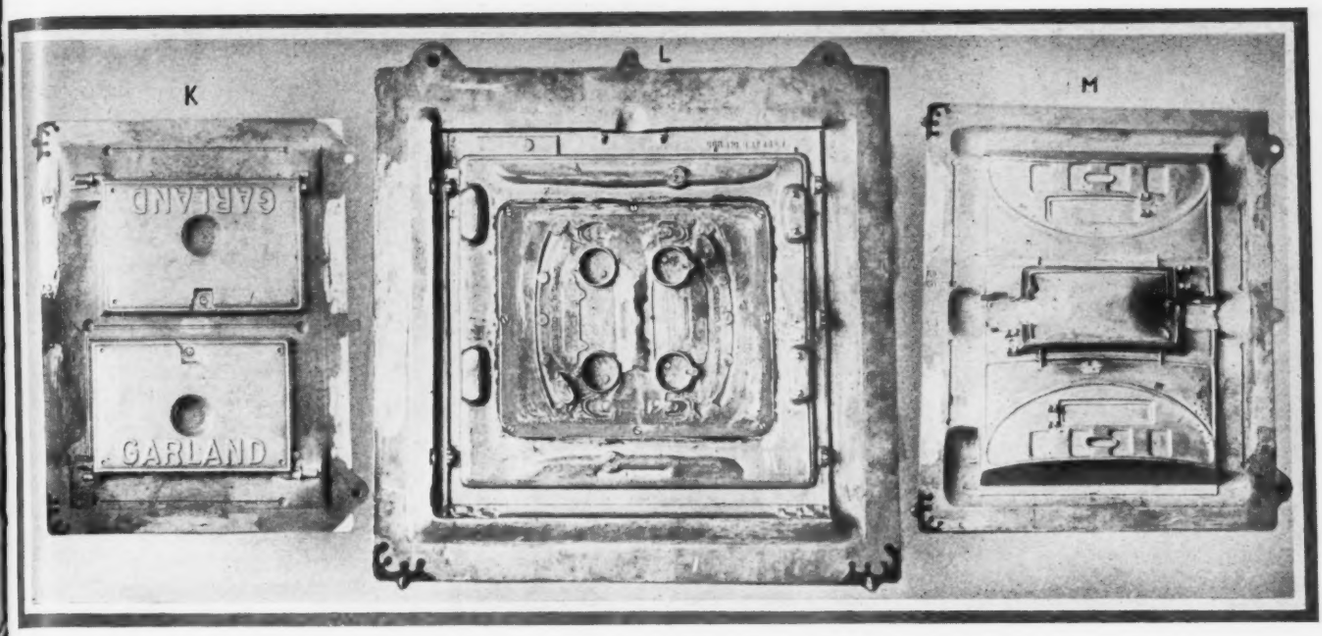


FIG. 17—LARGE ALUMINUM MATCH-PLATES FOR MOLDING STOVE PLATE

variation in the shrinkage of the match-plate, and eliminates fitting due to this cause. The match-plate is held rigidly by the other hinge, and in addition the two hinges hold the match-plate so firmly that any movement back and forth is impossible. The match-plate hinges setting in the drag hinges are shown at *I*, and *K* is a side view of a flask with the match-plate interposed between the cope and drag, showing the contact of the raised projections, *G*, at the corners, with the match-plate.

Use of Match-Plates on Squeezers.

The use of these match-plates on squeezers for small work, such as is ordinarily made on the bench, has resulted in a material increase in the output per day, and in addition the castings are more uniform in size and weight. Farwell squeezers, built by the Adams Co., especially equipped for match-plate work, are illustrated in Figs. 8, 9, 10 and 11. In applying the match-plates to squeezers a difficult problem had to be solved, caused by the tilting of the drag when the cope is rolled up. This is due to the lack of support at the back end of the drag, as the bottom board is used for squeezing and is mold size, causing the flask to project its entire thickness on the four sides of the mold after it has been rammed. To overcome this difficulty, two brass pins have been provided, as shown at *A*, Fig. 10, which can be raised or lowered by two wedges operating underneath the table, which are guided by handle *B*. When the operator is filling the flask with sand, these pins are in their lowered position, this being accomplished by drawing out handle *B*. After squeezing the mold, and before the cope is rolled back, the pins are raised by pushing in the handle and they contact with the back end of the drag flask, supporting it while the cope is swung back, and until the match-plate is lifted out and the mold is closed. One of these pins supporting one end of the drag flask,

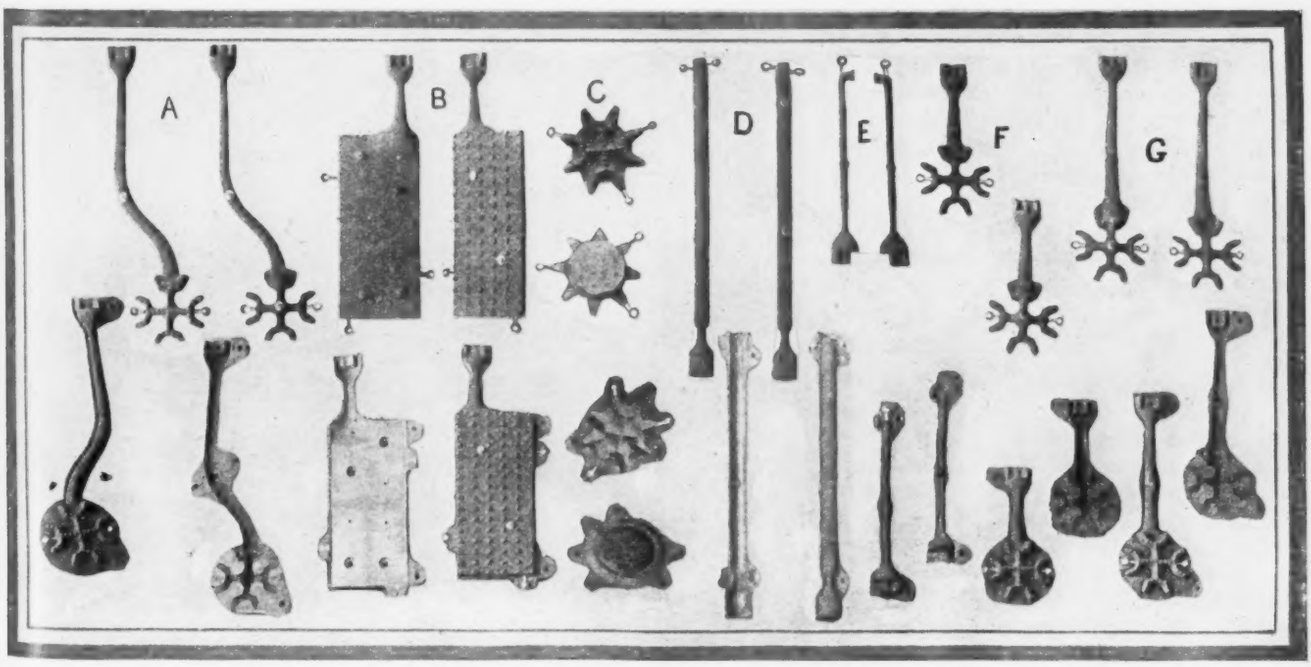


FIG. 18—CORES FOR GAS STOVE CASTINGS. THE FORMS IN WHICH THE CORES ARE DRIED ARE SHOWN IN THE BOTTOM ROW

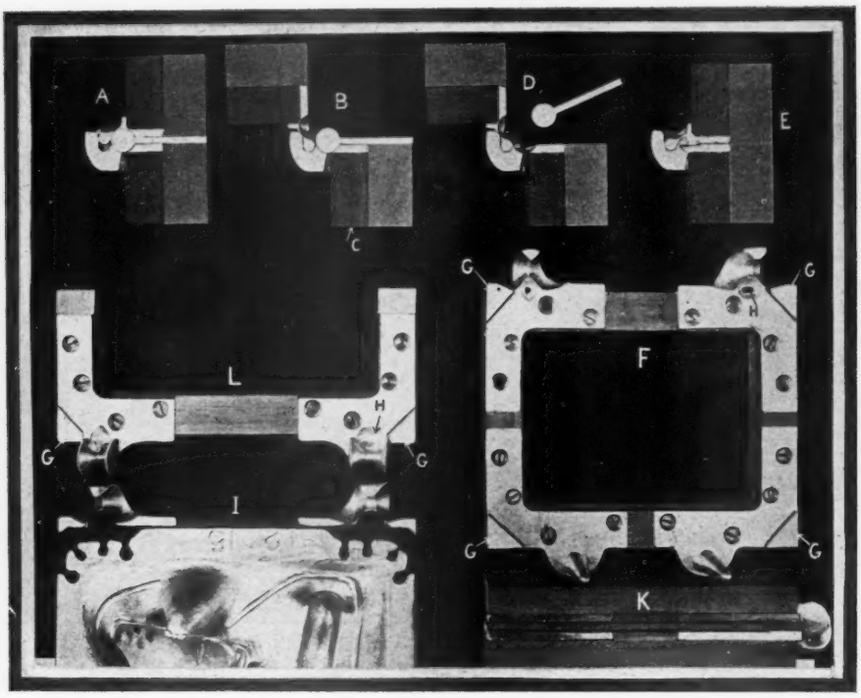


FIG. 19—THREE SECTIONS OF THE ROLL-UP HINGE, SHOWING HOW IT IS ATTACHED TO THE FLASKS AND MATCH-PLATE

which has been moved to one side to better illustrate the device, is shown in Fig. 8. It will be noted that the drag is well supported and is level throughout. Fig. 9 shows the result of not supporting the drag flask with these pins. The drag flask is tilted at the back as the result of rolling-up the cope, and the match-plate has been raised out of the drag half of the mold at one side, thus breaking down the mold.

The squeezer, Fig. 10, has been well equipped for match-plate work, being provided with a wide shelf at the top and a bench at one side for the flask and tools, while the riddle is supported at working height. A mold of two short stove centers, with the match-plate lifted up in position in which the operator holds the plate when dusting on the facing before printing-back, is shown in Fig. 11. This likewise shows one of the pins supporting the drag flask at the back, and a part of the handle is seen at *B*.

Gas Stove Works.

Modern molding machines installed by the Arcade Mfg. Co., Freeport, Ill., are also used for light work. On these machines both cope and drag are made in one operation, but two match-plates are used, the one containing the cope pattern and the other the drag. In Fig. 14, aluminum-zinc match-plates are shown which are without backing of any kind, the plate being made by the method in use at this foundry for making the other match-plates, and these are merely screwed into a cast iron frame. This has reduced the cost of making these plates materially, and in addition insures a very rigid construction.

Drag and cope match-plates of a pair of gas stove burners mounted on a Modern molding machine, with the drag and cope halves of the mold in the foreground, are shown in Fig. 14. The output per day of one handyman on this class of work is 125 molds, whereas without the machine the daily production of one molder is only 60 molds, thereby showing a saving in favor of the machine of about 80 per cent.

Cores for Gas Stove Castings.

It will be noted that the cores have been set in the drag, and the ease with which this can be accomplished, is worthy of special mention. Each core contains five chaplets, which are rammed up in the cores in the boxes in which they are made. These boxes are recessed to insure the exact location of the chaplets and their proper height in the mold. This obviates the necessity of setting the chaplets, which in a mold of this kind would be exceedingly tedious and in addition would involve the danger of breaking down the mold and extra finishing. The core is located in the mold by two spoon chaplets at one end, the mold containing the impression by which these chaplets are located. At the other end the core is located by a print.

Two gas stove burners mounted on match-plates on a Modern machine are illustrated in Fig. 15. In the foreground the drag half of the mold is at the left and the cope at the right. The cores in the drag contain four chaplets each, the two spoon chaplets at the one end being used for locating the core in the mold. These chaplets are likewise rammed in the cores while they are being made, thus eliminating the extra work of setting them by the machine operator before closing the mold. This core is located at one end by spoon chaplets, while the other end is held in a print. The snap flask shown is made of aluminum, and the results have been so satisfactory

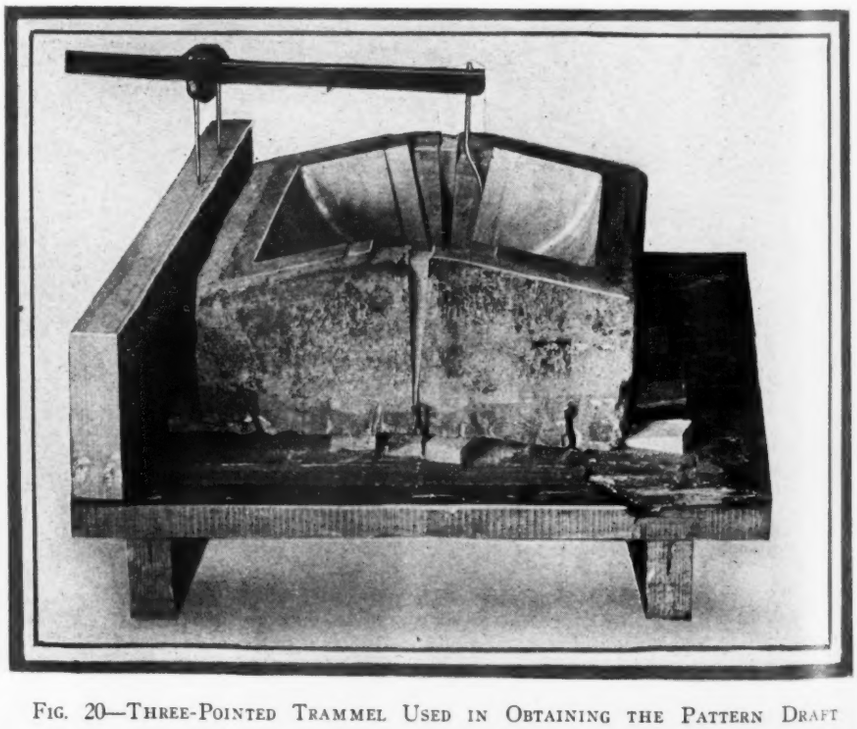


FIG. 20—THREE-POINTED TRAMMEL USED IN OBTAINING THE PATTERN DRAFT

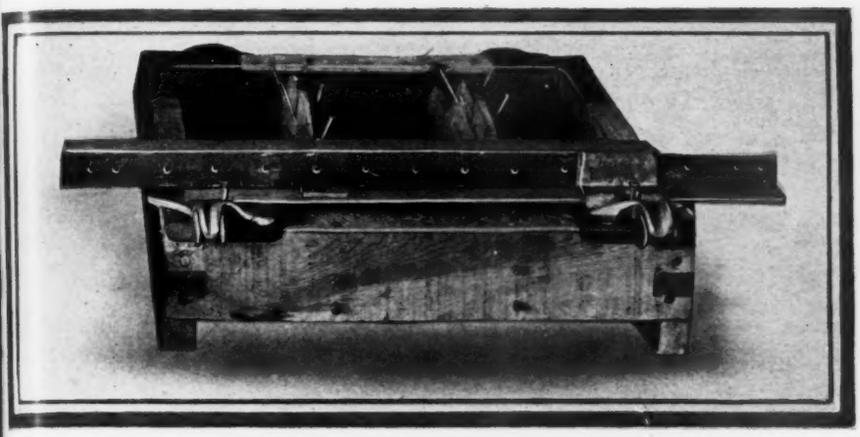


FIG. 21—TEMPLATE USED WHEN ATTACHING FLASK HINGES

that it has been decided to considerably increase this style of equipment.

Match-Plates for Floor Work.

An example of floor work is shown in Figs. 12 and 13. The match-plate contains the pattern of a gas stove top and in the center is a removable dead-head of two lighter plates. These dead-heads are screwed to the match-plates, and all being of uniform size, permits interchanging them as the orders for castings in the foundry may require. This match-plate is 26 inches square, and the daily output of the handyman is 32 molds. When made on the floor without the match-plate, 23 molds per day was considered a good record. One man has produced as high as 42 molds in one day, this being the high mark, but 32 molds is the average. In Fig. 12, the mold has been stepped-off, the cope rolled-up, and the match-plate has been rolled-up and hooked to the cope while the molder dusts on the facing before printing-back. In Fig. 13, the pattern has been printed-back and the match-plate lifted out preparatory to closing the mold.

Reduction in Molding Time.

On bench work, using the match-plate, the number of operations necessary for making a complete mold has been reduced to 33, as compared with 51, using a cast iron pattern and follow-board, the mold being stepped-off. For the purpose of an accurate comparison, the molds were made in the same size flask, 12 x 21 inches. The match-plate, by the new method on a squeezer, contained the pattern of a gas stove grid, while the iron pattern was that of a fancy base side. The time required for making the mold on the squeezer was 1 minute and 30 seconds, or an average of 240 molds in seven hours. One molder, working leisurely, put up 182 molds in seven hours, an average of 2 minutes and 41 seconds for each mold. This same molder put up a similar mold in the "old way" in 4 minutes and 21 seconds. This is a reduction in the time required for making a mold on the squeezer by a speedy molder, of 2 minutes and 55 seconds, as compared with the "old way," and considering the slower record, the reduction in time is 1 minute and 44 seconds.

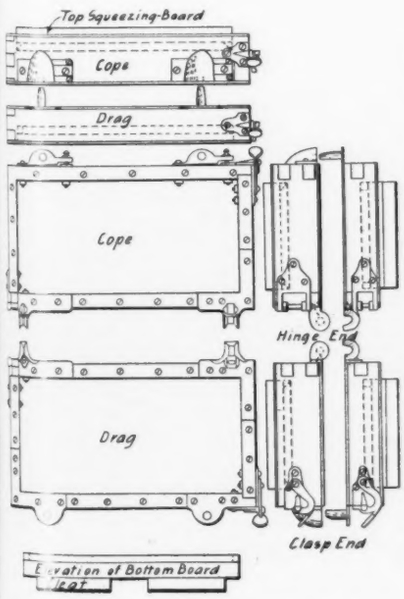


FIG. 22—HINGED SNAP FLASK FOR HINGED MATCH-PLATE AND DUPLEX SQUEEZER

The operations performed by the molder on the squeezer with a match-plate, follow:

Brushes pattern.
Puts pattern in flask.
Puts flask on machine.
Riddles sand on pattern.
Shovels drag flask full of sand and shovels some sand in riddle.
Tucks edges with hands.
Strikes-off with bottom-board.
Sets bottom-board on flask.
Rolls flask over.
Picks up riddle and covers pattern with sand.
Places riddle on shelf.
Shovels cope flask full of sand and shovels some sand in riddle.
Tucks around edges with hands.
Strikes-off with cope board and puts board on.
Pulls squeezer head over and squeezes the mold.
Throws back squeezer head.
Takes off cope board.
Raises pins supporting back of drag flask.
Cuts sprues.
Raps match-plate.
Rolls up cope.
Blows out sprue hole with mouth.
Raps surface of match-plate and rolls up the same.
Dusts facing onto mold.
Jars plate down and raps.
Rolls up and lifts out match-plate and places same on bench.
Inspects the mold.
Closes the flask.
Lowers pins supporting back of drag flask.
Raps flask down with mallet.
Removes snap flask.
Locks the flask.
Puts mold on the floor.
Number of operations, 33.
Time, 1 minute and 30 seconds.

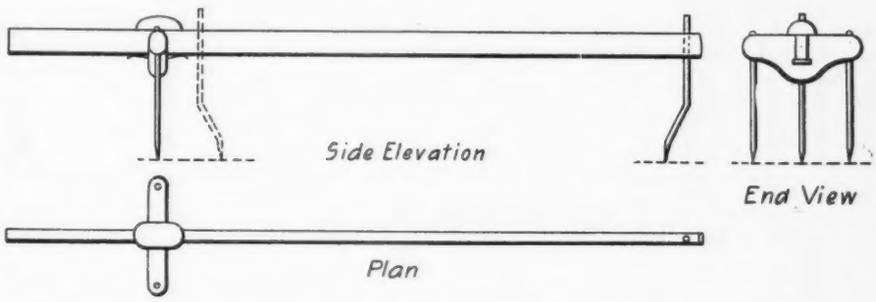


FIG. 23—SIDE ELEVATION, PLAN AND END VIEWS OF THREE-POINTED TRAMMEL, SHOWN IN FIG. 20

Average for seven hours, 240 molds.
Molder working slowly put up 182 molds in 7 hours, an average of 2 minutes and 41 seconds for each mold.

Bench Work, "Old Way."

The operations performed by the molder using a cast iron pattern and follow-board with the same size flask as above, follow:

Brushes pattern.
Puts pattern on bench.
Locks drag.
Puts drag on pattern.
Shakes parting sand on pattern.
Puts riddle on drag.
Puts sand in riddle.
Riddles sand on pattern.
Takes riddle off and hangs it on the bench.
Shovels drag full of sand.
Rams with shovel handle.
Levels sand with hands.
Uses rammers (sides and with butts).
Picks up strike-off.
Strikes-off.
Puts strike-off on bench.
Beds for bottom-board.
Puts bottom-board in place.
Rolls flask over.
Takes off bottom-board.
Brushes pattern and raps pattern.
Blows off with bellows.
Puts on cope.

Sets sprues.
Uses parting sand.
Puts riddle on cope.
Fills riddle.
Riddles sand on pattern.
Takes riddle off and hangs on bench.
Tucks sprue.
Shovels cope full of sand.
Rams edges with shovel handle.
Levels off with hands.
Uses rammers (sideways and butts).

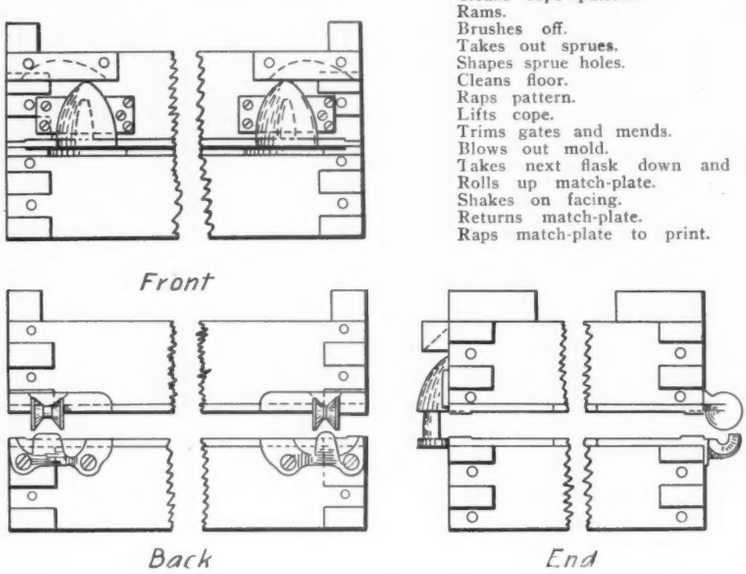


FIG. 24—FRONT, BACK AND END VIEWS OF 2-INCH FLOOR FLASK

Lays drag down.
Levels flask.
Fins-in.
Sets sprues.
Shakes on parting compound.
Riddles sand.
Shovels flask half full.
Tucks with hands.
Shovels flask full of sand.
Shapes with the hands.
Steps off cope.
Cleans cope pattern.
Rams.
Brushes off.
Takes out sprues.
Shapes sprue holes.
Cleans floor.
Raps pattern.
Lifts cope.
Trims gates and mends.
Blows out mold.
Takes next flask down and raises drag.
Rolls up match-plate.
Shakes on facing.
Returns match-plate.
Raps match-plate to print.

Uses strike-off.
Lays down strike-off.
Cuts away sand for sprue.
Draws sprue.
Jars flask.
Takes off cope.
Blows off cope with bellows.
Draws pattern.
Puts on facing.
Returns pattern and raps.
Uses bellows on cope.
Raps pattern.
Draws pattern and puts it on the follow-board.
Inspects mold.
Puts back cope on drag.
Takes flask off.
Puts mold on floor.

Number of operations, 51.
Time, 4 minutes and 25 seconds.

Floor Work, "New Method."

A comparison of the old and new methods on floor work shows a reduction in the number of operations necessary, when using the hinged flasks and match-plate, from 65 to 52, and the time for making the molds in the same size flask, 26 x 28 inches, was reduced from 18 minutes to 10 minutes.

On floor work the number of operations required by the "new method" of making a mold, follow:

Brushes pattern.
Blows off pattern.
Puts on drag.
Shakes on parting compound.
Clamps.
Riddles sand.
Shovels drag half full.
Rams with shovel handle.
Shovels flask full.
Cleans shovel.
Levels off the sand with hands.
Steps-off both ways.
Removes clamps.
Strikes-off.
Sprinkles sand.
Puts on bottom-board.
Clamps.
Rolls up drag.
Cleans floor.
Rolls up match-plate.
Lays match-plate on cope.
Blows off cope.
Closes cope.
Clamps.
Places mold.
Changes tool box.

Number of operations, 52.
Time, 10 minutes.
Thirty-two molds is considered a fair floor.
Trolley is furnished for conveying the metal when pouring off.

It takes two minutes to shake out, trim castings and wet down the sand for each flask put up.

Floor Work, "Old Way."

The number of operations on floor work the "old way" are as follows:

Brushes pattern.
Sets gates.
Blows off pattern.
Puts on drag.
Shakes on parting compound.
Riddles sand.
Shovels drag half full of sand.
Rams with shovel handle.
Shovels flask full of sand.
Cleans shovel.
Levels off sand with hands.
Steps-off both ways.
Strikes-off.
Sprinkles sand.
Puts on bottom-board.
Clamps.
Rolls up drag.
Cleans floor.
Lays drag down.
Levels flask.
Clamps off.
Takes off follow-board.
Blows off and makes parting.
Puts on parting sand.
Blows off.
Fins-in.
Sprinkles on parting sand.
Puts on cope.
Clamps.
Sets sprues.
Riddles sand.
Shovels flask half full of sand.
Tucks with hands.
Fills flask with sand.
Shapes with hands.
Steps-off cope.
Cleans off cope pattern.
Rams.
Brushes off.
Takes out sprues.
Shapes sprue holes.
Cleans floor.
Wedges up.
Lifts cope.
Lays down follow-board.
Trims gates and mends.
Blows out.
Draws top pattern.
Lays down the board.
Finishes and mends drag.
Shakes on facing.

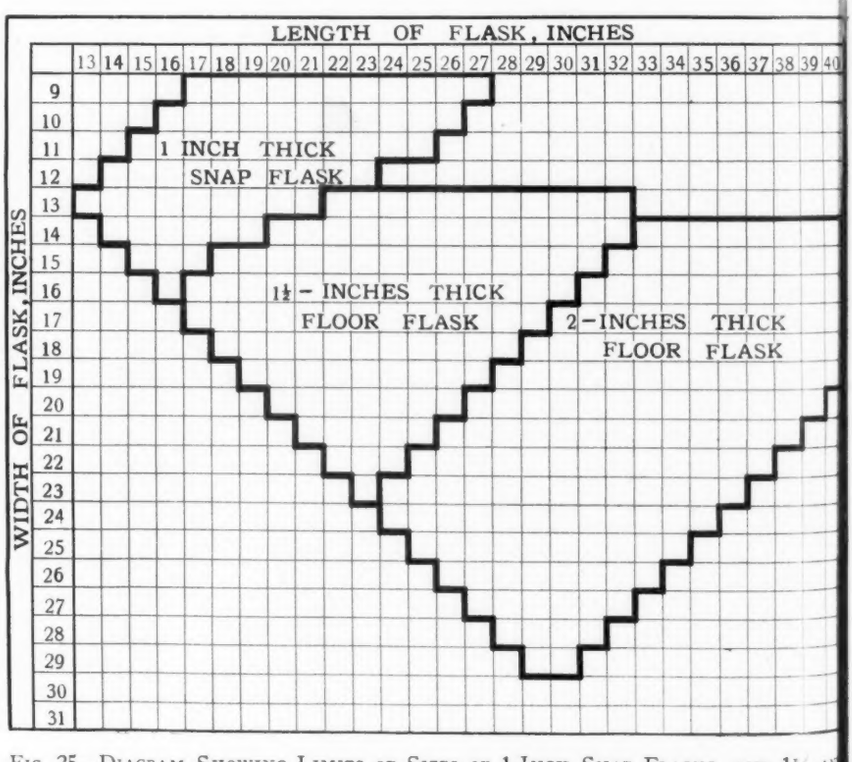


FIG. 25—DIAGRAM SHOWING LIMITS OF SIZES OF 1-INCH SNAP FLASKS, AND 1½ AN 2-INCH FLOOR FLASKS

Returns pattern.
Takes out set gates.
Draws deadhead.
Swabs the mold and blows out.
Raps pattern to print.
Blows off.
Draws top pattern.
Lays on follow-board.
Finishes mold.
Blows off cope.
Closes cope.
Clamps.

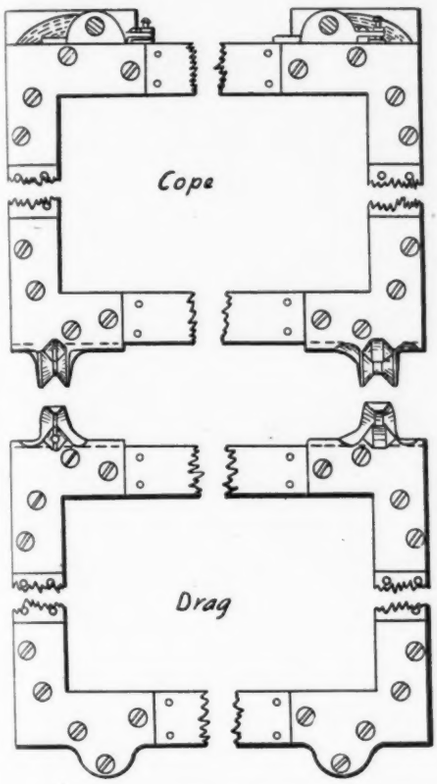


FIG. 26—COPE AND DRAG OF 2-INCH FLOOR FLASK

Places mold.
Changes tool box.
Number of operations, 65.
Time, 18 minutes.
A fair floor consists of 22 molds.
No trolley furnished.
It requires 2 minutes to shake out, trim castings and wet down the sand for each flask put up.

Classification of Flasks.

All of the snap flasks are made of 1-inch lumber, while the floor flasks, according to size, are made of lumber 1½ and 2 inches thick. After considerable experimenting the maximum sizes of flasks for bench and floor work have been determined, and the limits in the sizes of flasks that are made of 1½-inch and 2-inch lumber have also been ascertained. The division of these flasks into three classifications is graphically shown in Fig. 25. The limit in the length of the snap flasks is 27 inches, while the greatest width is 16 inches. The greatest length for floor flasks made of 1½-inch lumber is 32 inches, and the greatest width, 23 inches. For 2-inch floor flasks the greatest length is 40 inches, and the limit of width is 29 inches. However, from the diagram it will be seen that the limits in widths and lengths of the flasks in these three classifications are not included in the dimensions of any one flask.

Largest Snap Flask.

The snap flask having the largest area is used with a match-plate containing the patterns of gas range legs. This flask is 13 x 20 inches, and has a total area of 260 square inches. The flask is 3¾ inches deep, and after squeezing, the drag half of the mold is 3⅜ inches deep. The cope flask is 4¼ inches deep and after squeezing, the cope half of the mold is 3 15-16 inches deep. The drag half of the flask filled with sand with the cope, flask and match-plate in position ready to roll over, weighs 93½ pounds. The finished mold, ready to carry to the floor, weighs 105¼ pounds, which is the greatest weight any of the bench molders have to lift.

Largest 1½-Inch Floor Flask.

The largest 1½-inch floor flask is for a match-plate of gas range end shelves and is 20 x 27 inches in dimensions, having a total area of 540 square inches. The cope and drag flasks are each 4 inches deep. The greatest weight the floor molder is compelled to lift when making molds in flasks in this class is 185½ pounds, which is the weight of the drag rammed with sand, bottom-board and cope clamped on, together with the match-plate ready to roll over.

Largest Floor Flask.

The largest 2-inch floor flask is used for molding a steel range front. The flask is 26 x 33 inches and has an area of 858 square inches. The cope and drag are each 4 inches deep. This is the heaviest flask which the molders are compelled to handle and it weighs 289 pounds. This includes the drag rammed with sand with the bottom-board and cope clamped on and the match-plate in position ready to roll over. It has been found that this is the maximum weight that one man can conveniently handle on the floor without the assistance of a helper, and to obviate the introduction of a second man on this match-plate work, this total area of 858 square inches represents the limit of the sizes of both match-plates and flasks.

Weight of Aluminum Match-Plates and Iron Patterns.

A comparison of the weights to be handled by the molder in the aluminum

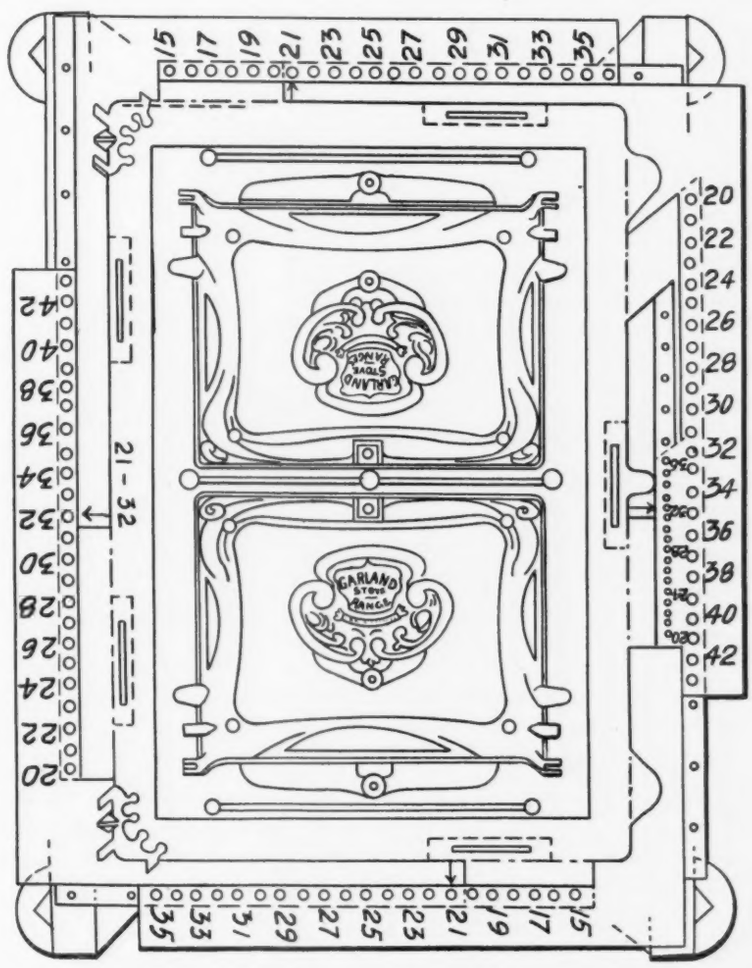


FIG. 27—ADJUSTABLE FRAME FOR MOLDING HINGED MATCH-PLATES FOR 2-INCH FLOOR FLASKS. THE FRAME IS ON THE DRAG OF THE MATCH-PLATE MOLD

match-plate process and the loose iron pattern follow-board method, is interesting, in that the aluminum match-plate process, contrary to what would generally be supposed, requires the handling of the greatest weight. The pattern, in this case, was that of a steel range front requiring a flask 26 x 33 inches. The aluminum match-plate weighed 51 pounds and the cope flask 30½ pounds, making a total weight of 81½ pounds to roll-over without the sand in the flask. The iron pattern weighed 22 pounds and the follow-board 46½ pounds, making a total weight of 68½ pounds to roll over without the sand in the flask. It will, therefore, be seen that the extra weight in working the aluminum match-plate, as compared with the loose iron pattern, is due to rolling over the match-plate with the cope, and amounts to 13 pounds.

Templates for Attaching Hinges.

For locating and attaching the hinges to both cope and drag flasks a template is used as shown in Fig. 21, which consists of two steel angles to which the template hinges are fastened. One match-plate hinge is attached to the one angle, while the second hinge is fastened to the other. The angles are graduated to 1 inch, and by moving the angles in and out, the hinges for any size flask can be accurately set. In addition, the openings for screws in the match-plate hinges coincide with the countersunk holes in the cope and drag hinge members, thereby permitting the screws to be driven into the flask with the template in position. The cast iron flask pin plates in the drag, as well as the plates containing the flask pin openings in the cope, are likewise located by template.

Hinged Snap Flask.

The construction of the hinged snap flask is shown in Fig. 22. The top of the cope flask and the bottom of the drag are fastened with strap iron, 1 x ½ inch, having welded corners, which will not open. The flask pin holes are protected from the sand by cone-shaped sockets, and the location of the flask pin holes can be adjusted by set screws to take up wear. The elevation of the bottom-board, Fig. 22, shows two wide cleats, which prevent the board from bending while squeezing the mold.

Floor Flasks.

Plan views and front, back and end elevations of a 2-inch floor flask are shown in Figs. 26 and 24. The four sides of each flask are dove-tailed together, insuring a rigid construction, and to accomplish this work rapidly in the pattern shop, a machine was especially designed and built by Mr. Keep. The flask pin and flask pin hole plates are similar to those used on the snap flasks.

Cores and Drying Forms.

A varied assortment of gas stove cores and the cast iron forms, in which they are dried, are shown in Fig. 18. Metal core boxes are used exclusively in the core department of this foundry, and these boxes contain recesses into which the chaplets are set when the cores are being made. This insures the accurate location of the chaplets, and furthermore aids the molder in setting the cores in the molds. To facilitate locating the cores in the molds, spoon chaplets are used. All of the cores are placed on cast iron forms, which conform exactly to the shape of the cores, thereby eliminating the possibility of their getting out of shape while they are being baked. Top and bottom sides of the cores are shown in the upper row, Fig. 18, which clearly illustrates the distribution of the chaplets. The cores in the forms on which they are dried, as well as the forms with the cores removed, are shown in the lower row, Fig. 18.

The cores in the upper row are as follows: *A*, curved gas stove burner core with two spoon chaplets at one end, a total of five chaplets in the core; *B*, core for gas heater burner, eight chaplets; *C*, cap burner core, three spoon chaplets; *D*, core for an oven burner, four chaplets; *E*, core for simmering burner, three chaplets; *F*, core for a star burner, three chaplets; *G*, core for a star burner, four chaplets.

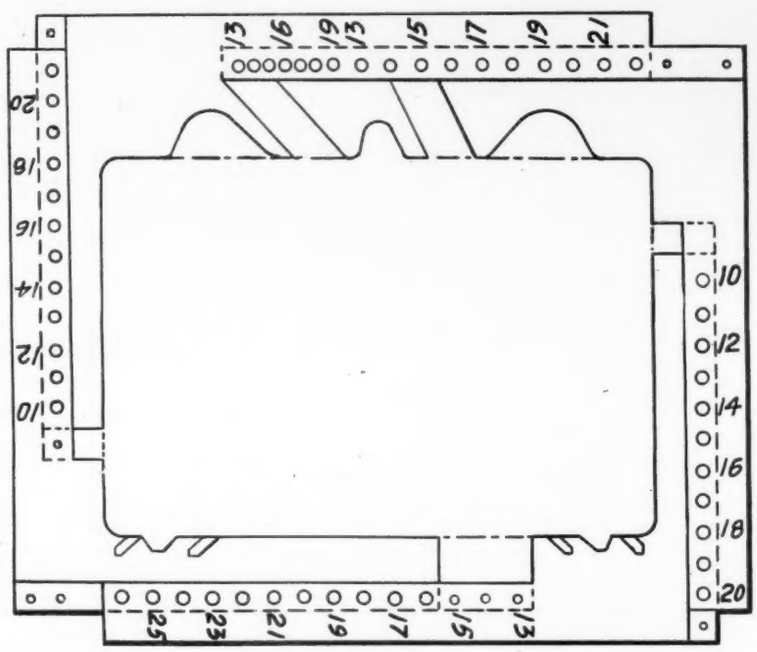


FIG. 28—ADJUSTABLE FRAME FOR MOLDING HINGED MATCH-PLATES FOR BENCH WORK

EXPANSION OF CAST IRON.

In May, 1909, the Crane Co., Chicago, made two straight bars of cast iron, ¼ by ½ inch, accurately machined. One bar measured 18.336 inches and the other 23.382 inches. These bars were placed in a steam-heated core oven where there is an even temperature of 325 degrees Fahr. At the end of five weeks the shorter bar had a permanent expansion of 0.003 inch, and the longer 0.008 inch, the lengths being 18.339 inches and 23.390 inches.

In July the bars were transferred to a second oven in which the temperature fluctuates a little, but averages 600 degrees Fahr. After being in this oven 30 days the lengths had increased 0.145 inch and 0.177 inch.

The bars were then returned to the oven for another 30 days and gained 0.014 inch and 0.028 inch, respectively, in the second period.

	Ins.	Ins.
Original lengths	18.336	23.382
Gain in five weeks at 325 degrees	0.003	0.008
Gain in thirty days at 600 degrees	0.145	0.177
Gain in thirty days at 600 degrees	0.014	0.028
Final lengths	18.498	23.595

The permanent expansion at a temperature of 325 degrees (equivalent to 82 pounds steam pressure) was very small, but at 600 degrees it equalled in 60 days, 0.104 inch per foot on both bars, which is an extraordinary amount.

The measurements were taken with the greatest care and carefully checked. Further experiments along this line of investigation are being conducted.—*Valve World.*

FIG. 1—INTERIOR VIEW OF THE GOODELL-PRATT CO.'S REINFORCED CONCRETE FOUNDRY

A Reinforced Concrete Foundry Building

BY WALTER B. SNOW

THE recent additions to the plant of the Goodell-Pratt Co., tool manufacturer, Greenfield, Mass., consist of a foundry, 120 x 75 feet, pattern shop, 54 x 21 feet and a machine shop, 40 x 35 feet. These buildings were erected by the Aberthaw Construction Co., Boston. They are of reinforced concrete construction with the exception of the machine shop, which is of brick with reinforced concrete beam floors and roof. Both the machine and pattern shops are three stories high.

It has been the aim, as far as possible, to eliminate all columns, thereby insuring an unbroken floor area and a uniform distribution of light. The pattern shop is entirely free of columns, the beams, which are about 6 feet apart, furnishing all the support necessary.

The new foundry, interior view of which is shown in Fig. 1, occupies the largest area, and has a casting floor clear of all obstructions, 120 x 44 feet, with a clear height of 25 feet under the large, transverse reinforced concrete beams. On the east side is a gallery 30 feet wide which extends the entire length of the shop, and is shown in Fig. 3. The walls at the sides are 6 inches thick between pilasters, which are placed 20 feet apart. The walls at the ends of the foundry are 9 inches thick, and those between the buildings are 12 inches in thickness.

The concrete foundations are carried down about 5 feet below grade. These are in the nature of sills, being about 3 feet deep and 4 feet wide, reinforced with steel rods imbedded in both the top and bottom surfaces. The walls and wall pilasters are built integral with these foundations. Where there is considerable weight to be supported, as under the machine shop, the foundations are from 6 to 8 feet wide.

The roof, including a monitor over the casting floor, is of reinforced concrete supported by reinforced beams of large dimensions. The monitor is located over the middle of the casting floor and extends the length of the foundry. A gallery occupies an entire side of the casting shop. The charging floor of the cupola is the only part of the gallery which is not of reinforced concrete construction. The floor consists of steel plates, 5/16 inch thick, resting on steel I-beams. An elevator is provided for lifting coke, pig iron and scrap to this floor. The stairway leading up to the charging floor is of reinforced concrete and is provided with iron pipe railings. At the edge of the gallery is a 6-inch concrete wall, 4 feet high.

Plenty of light and ventilation is provided for in the foundry as well as in the pattern and machine shops. Large windows occupy most of the space between the wall columns, and the sides of the monitor are practically all window area. The sashes in the monitor are pivoted horizontally so that they may be opened for ventilating purposes, and in addition,

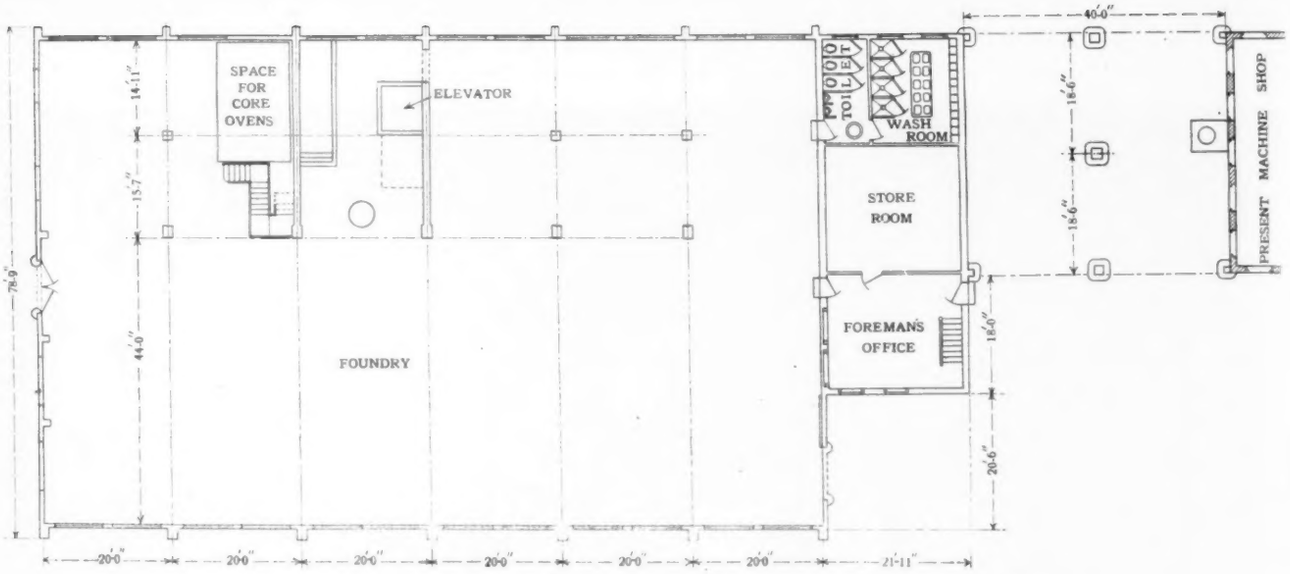


FIG. 2—GROUND FLOOR PLAN OF THE GOODELL-PRATT CO.'S REINFORCED CONCRETE FOUNDRY

the windows in the foundry are hung on vertical pivots so that in connecnection with the open monitor sashes, a good circulation of air may be maintained.

CARBON CONTENT OF MALLEABLE CASTINGS.

Question:—We find that our malleable castings, which have a black fracture and contain 2.75 per cent graphitic carbon, machine easily, whereas those having a gray fracture can only be machined with difficulty. The latter contain 2 per cent graphitic carbon. In the production of the castings having a gray fracture we use coke iron entirely and pack them in rolling mill scale when annealing. We have experimented with sand in the annealing furnaces, but could not obtain the desired results. Is it necessary to use iron high in total carbon?

Answer:—Analyses of graphitic carbon or any other kind of carbon in annealed malleable castings are misleading and do not mean anything, inasmuch as the carbon has been removed in varying quantities from the surface to the interior, thereby reducing original total carbon in the hard piece. To get the rich black interior, it is necessary not only to have a high total carbon in the pig irons used—which is not troublesome when good irons are purchased, and by these we mean those made especially for malleable casting work, and not off-Bessemer—but it is also necessary to conduct the melting operations properly, and to anneal correctly.

Anything that has a tendency to reduce the total carbon in the mixture, such as steel scrap additions, excessive percentages of sprues, annealed malleable scrap, and keeping the metal in the furnace too long when melting, will work against the rich black fracture. The charcoal irons formerly used always contained a high percentage of total carbon, and as about 50 per cent of charcoal iron was the rule in mixtures, no steel being added, the castings had a fine velvety fracture, dead black in color. You should experience no difficulty whatever in obtaining coke iron containing total carbon, about 3.50 per cent. You should specify "Coke Malleables" when making pig iron purchases.

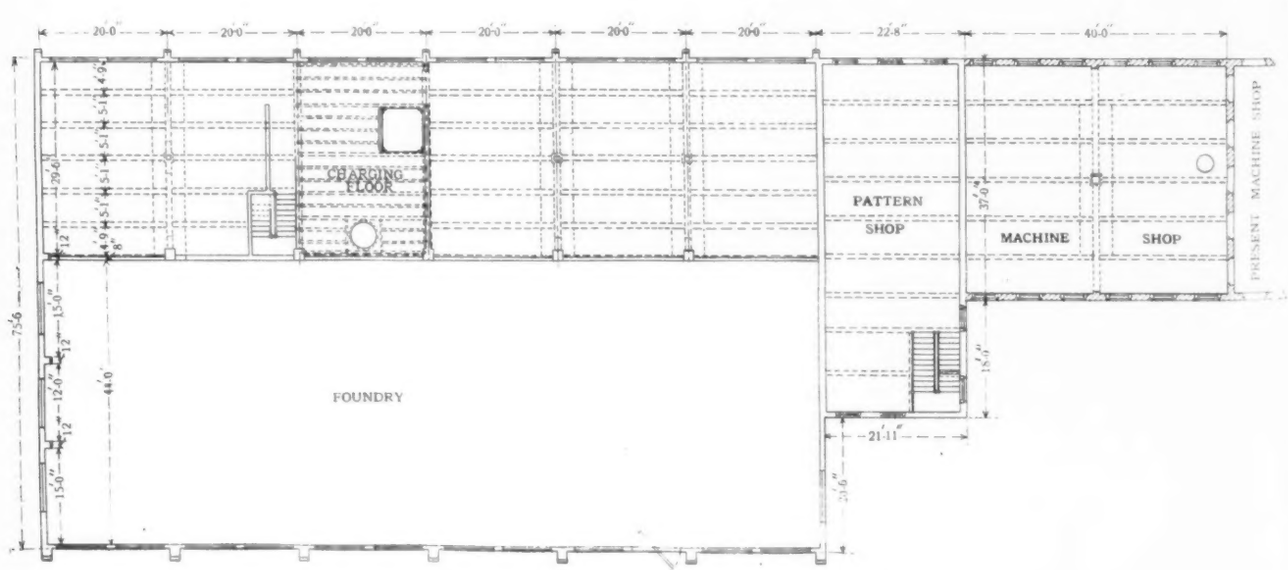


FIG. 3—BALCONY FLOOR LEVEL OF THE GOODELL-PRATT CO.'S FOUNDRY

ENAMELED CAST IRON SANITARY WARE-X

The enameling of cast iron including the mixtures for the slush and enameling coats --- Mixtures for colored enamels

BY DILLEN UNDERHILL

THE enameling of cast iron will be considered under three classifications, as follows: First, the ingredients which are used to make the enamel; second, the process of reducing these ingredients to thoroughly unite them to produce the enamel in a powdered form, and third, the method of applying the enamel and the apparatus necessary for this work.

In the first of this series of articles it was stated that the enameling mixtures of the various sanitary ware manufacturers are considered almost priceless trade secrets. This is only partially true. Each manufacturer believes that his formula is entirely his own, but there are few concerns, which do not possess the formulas of other firms, and many of the mixtures are in use, in whole or in part, in the plants of many competing manufacturers. There are hundreds of different enameling formulae, and many of these are in the hands of men who are working, or who have worked, in some department of enameled ware manufacturing plants. These formulae, however, are like mining stock, there are only a few good ones to be found among the hundreds that have been devised.

However, a knowledge of the ingredients is not the only essential necessary to the production of enameled ware. A man may gain access to the mixing room and obtain a list of all the ingredients used. However, he still lacks the knowledge of the proper quantities of each that are used, and furthermore, should he obtain the approximate amounts of each of the ingredients, it is necessary that the iron itself, to which the enamel is applied, should contain the proper percentages of the various elements to unite properly and form a bond with the enamel itself.

Changes of Formulas.

Even in the most modern plants, and especially in those where a chemist is not employed, the ware will at times begin to chip, and changes must be made in the regular formula. It may be found necessary to begin to use some formula that has been discarded in place of one which is considered an improvement over the formula previously in use. These changes may also be necessary in the first or slush coat, and like other branches of this business, changes are made from time to time if it is believed that the enamel can be improved upon. Notwithstanding the changes that are constantly being made, there are certain basic ingredients that are practically always used in these mixtures, and it is these that we will discuss, rather than a single formula.

Porcelain Enamel.

Porcelain enamel, so-called, which is used as a coating on cast iron sanitary ware, is a form of glass, in fact, before being ground, or while cooking in the melting furnace, it is known as glass. The various forms of glass are composed of silicates of different metallic oxides, with a considerable excess of silicate dissolved in them. Such other materials are added to give the enamel the proper color, elasticity, toughness and adhesion as are found necessary in the production of this ware.

Glass.

Glass somewhat resembles a salt, or in other words, it is the result of the reaction of an acid with a base. It does not, however, contain any water of crystallization as a rule, nor does it tend to any crystalline form. It is amorphous, that is to say, it is like a mass of pitch or asphalt when cold, or similar to shellac varnish or glue when hardened in a large body. Enamel or glass when struck a hard blow will shatter along the lines of least resistance. For instance, if the outside of a tub is given a hard, sharp blow with a hammer, the enamel will usually come off in the shape of a cone or pyramid. The apex will be close to the point where the blow was struck, while the base will extend outward toward the surface of the enamel, without showing a tendency to follow a definite line of cleavage, all particles apparently being united in all directions with equal strength. If, however, the enamel does not adhere to the tub perfectly, it will fall off in flakes, or it will break like a flat piece of ice, which is overhung or insufficiently supported. In short, it has no definite structure or grain.

In applying enamel on cast iron or wrought iron, where two distinct mixtures are used, the first is known as the slush or wet coat, and the second is the enamel itself or the finishing coat. The slush is the base which binds the finishing coat to the metal. The ingredients in the wet coat must, to some extent, unite with the metal itself. This slush coat must be more than simply a glue, as it were, and which some enamelers still think should be its real quality. The slush itself is an impure glass, as is shown by the constituents of at least two mixtures, which have been used in cast iron enameling plants.

The Slush Coat.

The slush is melted in a glass melting furnace and is then run out into water, where it crystallizes. After crystallization, it is placed in a revolving chamber called a mill, where it is ground with water. It is the practice in some plants to melt a single lot of ingredients and to add others after these have been put through the wet mill. In other plants two lots of ingredients are each melted and ground separately, and other ingredients are added after the mixtures have been taken out of the wet mill.

To make a slush or wet coat, which we will term *A*, mix together sand, borax, red lead and cobalt. This is melted and ground in a water mill. Another mixture is then made and is ground separate from the first lot. It consists of sand, borax, feldspar and red lead. The first and second lot of ingredients are then mixed together, and borax, China clay, epsom salts and ammonia are added. This will give a grayish colored liquid.

Second Slush Coating.

Slush *B* consists of sand and borax, melted in a furnace, and is ground in a wet mill. Borax and German clay are then added to this mixture in the wet mill after the sand and borax have been thoroughly mixed.

First Enameling Mixture.

Below is given an enameling mixture

which is used in conjunction with slush coat *A*:

WHITE ENAMEL A.

Feldspar	$KAlSi_3O_8$
Borax	$Na_2B_4O_7 + 10H_2O$
Oxide of tin	SnO_2
Fluorspar	CaF_2
Red lead	Pb_3O_4
Saltpetre	KNO_3
Oxide of zinc	ZnO

These chemicals are either in a powder or crystalline form, and are mixed in a can or box and emptied into the glass furnace. The mixture is cooked until it stops boiling, after which it is drawn off through a spout into a tank of water, where it solidifies in small pieces of white glass and is similar in appearance to the white coating or enamel on cast iron. After it is removed from the tank it is thoroughly dried. It is then ground under two large wheels, which roll in a pan, or it is placed in a long circular flint mill, which contains flint pebbles and is there ground into powder. It is then ready for the enameling room to be sifted on the ware.

Second Enameling Mixture.

The second mixture, or enamel *B*, which is to be used with slush coat *B*, follows:

WHITE ENAMEL B.

Sand	SiO_2
Feldspar	$KAlSi_3O_8$
Borax	$Na_2B_4O_7 + 10H_2O$
Oxide of tin	SnO_2
Sodium of carbonate.	Na_2CO_3 (Enameler's soda)
Red lead	Pb_3O_4
Magnesia	MgO

Principal Ingredients of Mixtures.

A comparison of these mixtures is interesting. The slush coats given are in use by two different concerns, yet borax and sand are the principal ingredients of these mixtures, and they form the basis for the wet coats of more than 150 mixtures which the writer has compared. Comparing the two enamels, *A* and *B*, we find sand in *B* and not in *A*. However, it has been added more liberally in slush coat *B*. Of the other ingredients, we find feldspar, borax, oxide of tin and red lead in these two mixtures and in more than 200 which have been compared, and it is certain that they form the basis of the good enamel for practically all cast iron ware.

Silica.

Silica, or silicon dioxide (SiO_2), occurs in nature in the form of sand, flint, agate or quartz. When so found, it is crystalline in form, and when pure, it is dazzling white in color. Otherwise its color results from a small admixture of iron. Silicate is extensively used in the manufacture of glass and porcelain. Ordinary glass is a silicate of calcium and potassium or sodium. As a matter of comparison, the composition of flint, table and mirror glass is given below:

	Flint glass. Per cent.	Table glass. Per cent.		Mirror glass. Per cent.	
Sand or silica..	42.5	70.71	71.56	76.30	78.75
Sodium oxide...	....	13.25	12.97	16.55	13.00
Potassium oxide.	11.7	13.58	13.27	6.50	6.50
Lime or calcium oxide	0.5	1.92	1.29	0.65	1.75
Litharge or lead oxide	43.5				
Rouge or iron oxide	1.8				

Silicon Dioxide.

Pure silicon dioxide can be made by melting a finely powdered silicate or sand with sodium carbonate, thus forming sodium silicate. This is soluble in water, and if hydrochloric acid is added to the mixture a gelatinous mass of silicic acid separates out. By evaporating this mass to complete dryness, adding a small portion of concentrated hydrochloric acid and slowly treating with water, everything except the silicon dioxide may be dissolved. This is in a finely divided state and will be found to be perfectly pure silicon dioxide. This is insoluble in water and in most acids, a property of glass that is familiar to all. It dissolves, however, in hydrofluoric acid, forming tetrafluoride, and requires the temperature produced by an oxy-hydrogen blow-pipe to melt it. This particular property accounts for the slush in melting down at a low temperature. In other words, there is an excess of sand in it which must be reduced in quantity, or a reducing material added to make the slush melt easily, or "soft," as it is expressed in the enameling room. When silicon dioxide is melted by the oxy-hydrogen blow-pipe it loses its crystalline structure and becomes amorphous. It may be drawn out into threads, and if it is subjected to sufficient heat at this high temperature it can be worked like glass. Until recently it has not been possible to work this compound commercially on account of the temperature required. There is, however, one concern that has overcome this difficulty and manufactures vitreous or quartz crucibles. Therefore, we may look for the manufacture of a magnificent material from this compound, which will be a perfect non-conductor of electricity, unaffected by atmospheric influence, indissoluble by almost all chemical substances, perfectly translucent, and approaching the diamond in hardness.

Melting Pure Silicate.

Despite the difficulty experienced in melting pure silicate, it can be fused comparatively easy to form glass or slag by heating it with any metallic oxide such as soda, potash, magnesia, baryta, oxide of lead, oxide of iron, etc. This, therefore, forms the foundation of all glass, earthenware, pottery, so-called porcelain enamel, etc.

We will now consider the constituents of wet enamel *A*. If we separate feldspar into its constituent elements, we have,

$$2\,KAlSiO_8 = \begin{cases} K_2O \\ Al_2O_3 \\ Si\,O_2 \end{cases}$$

If we take away the CaF_2, B_2O_3, N_2O_5 and SiO_2, we have only the following oxides left: Al_2O_3, K_2O, NaO, Pb_3O_4, SnO_2 and ZnO. In short, the compounds are almost all in oxidized form, or in other words, they are not subject to change in normal conditions. Silica is capable of forming two classes of compound. One the glass, an insoluble silicate, which we are now considering, and the other, a soluble silicate, known as water glass. These may both be produced by proper manipulation with soda and potash.

Water Glass.

These soluble silicates are produced by heating powdered silicate with four or five times its weight of acid or potash and then boiling this mixture with water. This water glass resembles mucilage and may be thinned down with any amount of water. In its more liquid form it can be mixed with fire clay and is used for repairing the enameling furnaces. It is also employed for setting the agate bearings in cast iron supports for the knife edges of accurate scales. It is also largely used with lime and other materials for producing artificial stone and indelible whitewash. Water glass is a very peculiar substance. If it is mixed, while in the liquid form, with a pure acid such as hydrochloric, it is decomposed and the hydrochloric acid unites with the soda or potash to form sodium chloride—common salt, or potassium chloride. The silica is isolated and remains either dissolved in the water or in the form of a cloudy gelatinous mass, and this, when dried, becomes a light, fine powder of dazzling whiteness. In this state, strange to say, it is insoluble. It can be made soluble again, however, only by repeating the operation of converting the silicate into water glass with an alkali and then removing the alkali with hydrochloric acid. In the manufacture of enamel, only an insoluble silicate is required, and this is obtained by reducing the amount of soda or potash. If we melt together three parts of silica to one of soda, a higher temperature is required to fuse it, but instead of obtaining water glass, which is an opaque white mass, soluble in water, we obtain the white transparent glass which is insoluble in water.

The acid properties of silica are only fully developed by heat. At a low temperature it is a weak acid and silicate of soda is decomposed by hydrochloric acid, but at a red heat its acid properties become highly developed. The or

dinary glassmaker usually uses ocean sand for his quartz, but owing to the iron which almost all of this sand contains, the glass is usually dirty yellow in color or bottle green. Until recent years the soda and potash have also been somewhat impure, and a small quantity of magnesia is added to neutralize the effect of these impurities. Silica sand, mined at points away from the seashore, is therefore to be preferred.

Silica unites not only with alkali, but also with lead, lime, magnesia and clay. Depending upon the proportions of the latter, it forms glass of various kinds, but if the percentage of lime, magnesia and clay is large, the mixture does not become transparent and in fact only partly vitrifies. The latter is the condition of so-called solid porcelain. Crockery consists of clay, lime and magnesia, together with only a very small portion of silica, while earthenware consists of clay with only a small portion of silica in chemical combination with the clay itself. We therefore have a group at the head of which is the finest enamel or glass, and this is followed by solid porcelain, crockery, earthenware and brick. There is no distinctive line of demarkation, as one product shades into the other as the various ingredients are increased or reduced. This entire group may be glazed over with glass, provided the product will withstand the necessary heat to melt the enamel and is adapted for glazing. If the material is not adapted for glazing, in other words, if it does not have the same inherent qualities and practically the same coefficient of expansion as the glaze, the enamel will crack, or small hair lines known as "crazing" will develop in the enamel.

Alkalis.

The oxides of sodium and potassium are known as alkalis. Both oxides, either pure or united with other substances, are used in the enamels. Potash produces a white color and brilliancy, but if an enamel is desired which is easily fusible, elastic and malleable, soda is employed. Both of the alkalis named have the properties of rendering glass more easily fusible. Lead also promotes fusibility, but if hard and fusible enamels are desired, alkalis are used. However, enamels made fusible by using large quantities of alkalis are more liable to craze or crack, and have a less brilliant surface. Borax, which is a salt of soda, has similar properties.

Saltpetre.

In enamel-making, the nitrates or carbonates of soda or potash are employed to the best advantage. Saltpetre is a nitrate of potash (KNO_3). The nitrates are excellent in effect, but are expensive, as the nitric acid used in their production is costly. A carbonate of soda, called Enamelers' soda, which is practically free from iron, is extensively used and on account of its purity is held in high favor. When these alkalis are heated with the silica to a bright red, the acid character of the silica which has been dormant, comes into play, and being much stronger than the carbonic acid, drives it out of the carbonate. The first effect of this mixture is to froth and to drive out, in the form of steam, the large quantity of water of crystallization which the carbonates contain, and as the glass forms the carbonic acid is expelled and bubbles up through the glass. The water of crystallization of the carbonates of soda and potash varies up to as much as half their weight, and for this reason these are calcined to reduce the excess of water. Some of these, however, should be used with the contained water, on account of their high oxidizing power.

There is also considerable danger of the carbon from the carbonate of soda reducing some of the other ingredients to a metallic state. Oxide of lead is especially to be feared on this account, and when so reduced, causes the enamel to have black specks or to become black in color. For this reason the entire mass should be kept well oxidized and no single ingredient is as available for this purpose as nitrate of potash, about 2 per cent of which should be used in the mixture to properly guard against this trouble.

Borax.

Borax is one of the principal ingredients used in enamels for cast iron ware. At a red heat it melts, forming a transparent, colorless liquid. When its water is driven out or dehydrated, the salt is known as anhydrous or calcined borax. This is the form usually sold by druggists. When in its molten condition, borax combines with and dissolves metallic oxides. This action is familiar in the process of soldering, it being necessary to have a bright untarnished metallic surface to bring about a proper fusion of the metals. The action of borax is the same in enameling cast iron ware, as it reduces the oxide on the surface of the ware so that the sand in the slush coat, which has been melted, will adhere to the heated metal. For the same reason it is used in the finishing coat to reduce any excess of oxides, so that the different substances may form as strong a bond as possible with the casting. Furthermore, when melting the ingredients, the excess of water driven out of the borax, as the mixture is heated, aids the chemical reaction. The water passes out of the mixture in the form of a superheated steam, which permeates the entire mass and assists in uniting the molecules to form the glass or enamel desired. Glass made with borax unites easily with metallic oxides, and therefore takes color well. Oxide of tin, which produces a white color, is held well in suspension in glass or enamel of this kind. It also causes glass to become very liquid and to flow easily. For this reason, an excess of borax is often added to make easily fusible enamels. Borax, however, has its defects. Enamels containing an excess of this ingredient are liable to craze or crack and are low in elasticity. In some plants, when the enamel begins to spall off, it is necessary to readjust the mixture, and occasionally it will be found that the iron mixture is off. Furthermore, it is not always possible to obtain a uniform strength of the other ingredients, more especially when one or more concerns furnish the feldspar or fluorspar, and when an excess of borax is added, the chipping difficulty referred to, results.

Furthermore, enamels containing an excess of borax are very susceptible to moisture. It is possible that the borax, not being held entirely as a compound, has a tendency to absorb the excess of water driven off by the heat of the melting furnace. The final effect of this is to cause the ware to tarnish quickly and the finish is dull instead of bright. Frequently, enameled work which has been in service a good many years, acquires this dull finish, which undoubtedly has been caused by an excess of borax. It is worthy of mention that Faraday, desiring a highly refractory glass, found he could unite large quantities of lead with borax in the production of an optical glass which was splendid for certain purposes. However, it was found that it speedily tarnished, thus making it useless. Pure lead, dull and opaque as it is, when added as an oxide, makes possible the production of beautiful flint glass such as is used for cut glassware. On the other hand, beautiful stained glass windows have suffered from the rain as the result of the excessive use of borax. The maker of the glass, desirous of lowering the fusing point when melting, sacrificed one of the most essential properties of his product.

Oxide of Tin.

Oxide of tin, which is held in suspension, is responsible for the beautiful white color of cast iron enameled ware. White arsenic is also added occasionally, but as it is a deadly poison, its use is thereby limited. Phosphate of lime is used in the enamels for jewelry, but has been rarely used in enamels for cast iron ware. Large quantities of oxide

of tin are used in enameling plants, and some enamelers have gone to the expense of making oxide of tin for their own use. This is done by treating tin with concentrated nitric acid, a white powder being precipitated. When heated, this powder is converted into oxide of tin. It is infusible and is not acted upon by concentrated hydrochloric or nitric acid. Oxide of tin is also formed as a white powder by burning tin in the air and by heating some of the stannic hydro-oxides.

Red Lead.

Red lead is formed by heating lead oxide in the air. It takes up more or less oxygen, depending upon the care used in its preparation. For this reason, red lead only approximates the formula, Pb_3O_4, and the enameler can experience many difficulties with his mixtures if the lead is not obtained from one source. It may be of interest to note that lead oxide (Pb O) is formed in large quantities in the process of separating silver from lead at the smelting plants. It is a yellowish powder known as litharge, an old friend of the foundryman, extensively used in making sand matches. Red lead, when heated to a high temperature, loses its oxygen and returns to lead oxide. Lead used in enamels as an oxide forms a silicate of lead with the silica. The effect of its introduction in the enamel is to make it softer, more easily scratched and more elastic and more malleable. It is also of value as a flux. It also aids in reducing the melting point of both the enamel and the slush coat, and reduces the tendency of the enamel to craze or crack.

Glass containing oxide of lead in the proportion of one-third of its weight is known as flint glass and is used for telescopes, table ware, etc., on account of its high refractive power and its brilliancy. In introducing lead as an oxide in the enamels there is always danger that it may be reduced to its metallic state while it is being melted. A very slight quantity of free carbon in the mixture would accomplish this, inasmuch as carbon has the power to reduce to the metallic state, more than 30 times its weight in lead. Care must therefore be taken to introduce some oxides in the form of nitrate of potash, or saltpetre, as it is familiarly known. This is found in mixture *A* for white enamel.

Enameling ovens, in which coal is used for fuel, should have all trusses as well as the roof on which soot and dirt can lodge, brushed down at least once a week. This will prevent the soot from falling on the enamel and thus lessens the chances for the reduction of the lead to its metallic state.

Magnesium oxide (Mg O), or magnesia, as this compound is commonly called, is added to the enamel to harden it. Borax, as previously stated, softens the enamel and lowers the melting point. Magnesia is infusible and its effect is the opposite of that of borax.

Cobalt.

A small amount of cobalt (Co) is sometimes used. It gives a blue color to the enamel, and when the oxide is pure it is a very powerful coloring agent. One part in a thousand gives a fine royal blue color. The ore of cobalt, when roasted with sand, is called "saffre." This is also found in some enameling formulas. The color of cobalt is brightened by the addition of some oxide of aluminum or clay.

Fluorspar.

Fluospar or calcium fluoride is used as a flux. The fluorine which this contains in combination is extraordinarily active in uniting with other elements. Mineral fluorspar exists in extensive deposits throughout the country, and large quantities are used in enameling mixtures. Its use as a flux is due to the fact that it melts easily and does not in this form readily unite with the other ingredients. It simply serves as a liquid medium in which the reactions take place at high temperatures for hastening reactions, such as water does at ordinary temperatures. Cryolite (Na_3 Al F_6) which also contains fluorine, is also used by some enamelers for fluxing purposes. As it contains soda and aluminum, a corresponding reduction must be made in the other elements to equalize this excess. For this reason the two fluorines are by no means interchangeable.

Coloring Agents.

Colors in enamels for cast iron sanitary ware are seldom seen. Occasionally some concerns make sinks of another hue than white. On account of the low prices at which they are sold, the poorest enamels or sweepings are used on sinks. The sweepings are usually remelted and it is possible that the color, when given to these enamels, is to save remelting. In the wet process of enameling, which includes so-called granite ware, enameled signs and enameling on wrought iron, a steel enamel is applied in solution and is then permitted to dry. A different coat of enamel is given for each color. Black sesquioxide of cobalt (Co_2O_3) imparts to the enamel a blue color. It is brightened by the use of alumina and is darkened by using iron manganese or uranium. Saffre, which contains only about one-half black sesquioxide of cobalt is also used to obtain the same color. Black oxide of copper (Cu O) imparts a light sea green color to the enamel. The higher the temperature at which the enamel is melted, the deeper the green. It, however, has a tendency to make the enamel brittle.

Red oxide of copper (Cu_2O) is used to give either a transparent or opaque red color. Various shades can be made by the addition of oxide of zinc, oxide of cobalt, oxide of chromium and the oxide of uranium. The sesquioxide or ferric oxide (Fe_2O_3), also known as rouge, is also occasionally employed to produce a green color.

Black oxide of manganese (MnO_2) produces an enamel reddish purple in color when about 4 per cent is used. A violet hue is obtained when saltpetre is used freely to keep the manganese well oxidized. Mixed with rouge (Fe_2O_3) manganese forms a warm reddish brown color. Manganese with cobalt produces a bluish, violet color, and with cobalt, iron and copper, a deep black.

Sesquioxide of uranium produces a yellow color, but it is so weak that a 15 per cent mixture is required to obtain a deep yellow.

Chromium sesquioxide (Cr_2O_3) produces a dark green color.

Carbonate of nickel ($NiCo_3$) produces a cold sepia brown.

Copper with tin produces a deep red.

Ruby red and crimson are made from chloride of gold, protroxide of tin and potash.

The colors are large in number when all the different shades are considered, and while it would be possible to add many more mixtures, this is sufficient to give some conception of the necessary substances required to produce the more common colors in enameled ware.

MACHINERY DEALERS' CONVENTION.

The joint convention of the American Supply and Machinery Manufacturers' Association and the Southern Supply and Machinery Dealers' Association will be held in Jacksonville, Florida, April 5, 6 and 7. Headquarters will be at the Seminole Hotel. It was previously announced that this meeting would be held at Atlantic Beach, Florida, but as satisfactory accommodations could not be provided, the meeting will be held in Jacksonville.

MIXTURE FOR SOLDERING IRONS.

Question:—We would like to have a mixture for electric soldering irons.

Answer:—A good mixture for soldering irons follows: Copper, 96 per cent; zinc, 3 per cent; phosphor tin 1 per cent.

ELEMENTS OF PATTERN CONSTRUCTION-III

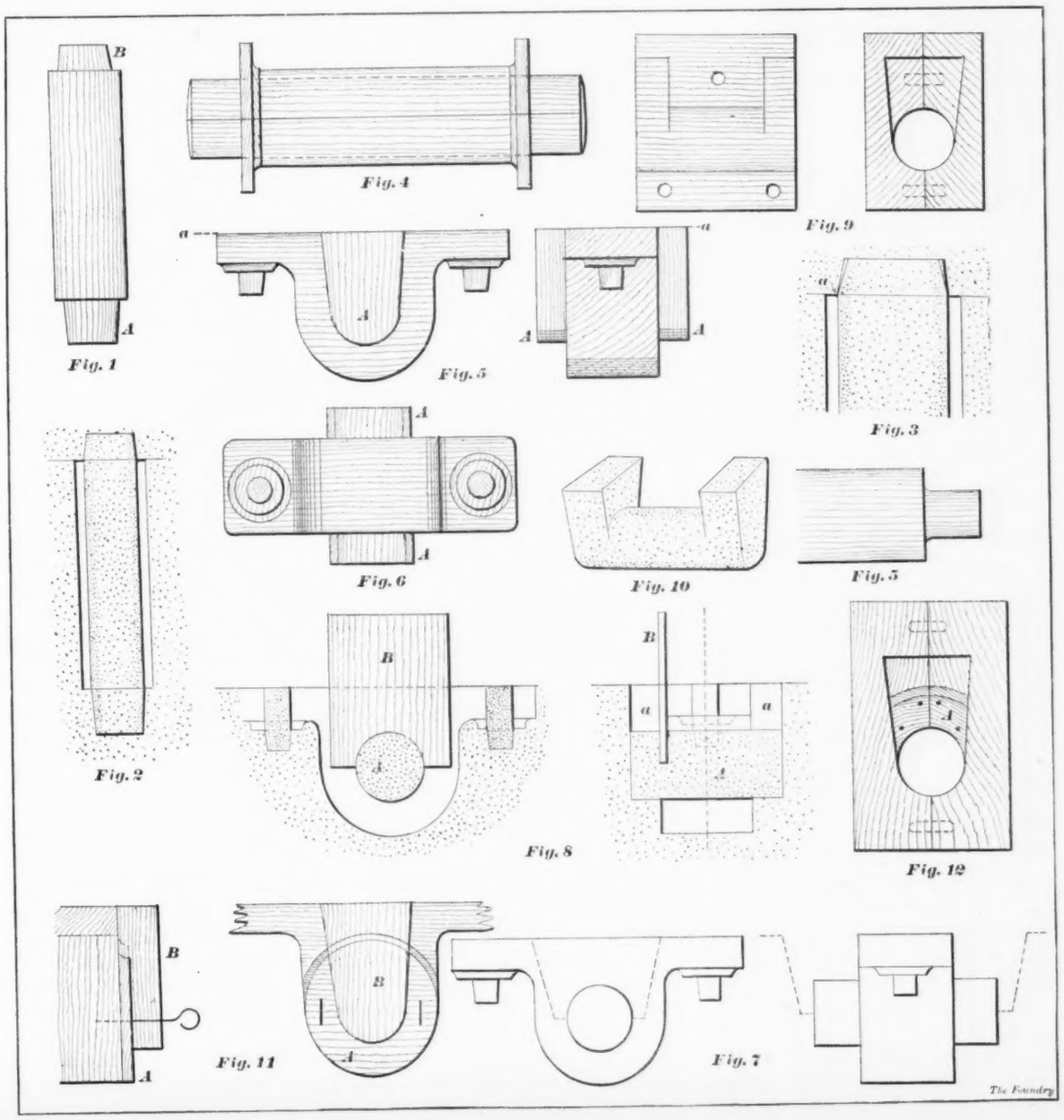
A comprehensive discussion of core prints, including simple and intricate vertical and horizontal prints, cores, etc.

BY JOSEPH HORNER

I DO NOT remember having seen the subject of the forms of core prints treated in a comprehensive manner. Until one begins to think over the subject, the great variety of these forms and their use, general and special, are hardly realized even by the patternmakers and molders, who are always making use of them. Prints are used, not only when absolutely necessary, but often as alternatives to self-delivery. They are often adopted simply because a stronger pattern can be made by using them, or a more accurate casting. They may be made in such a way that they will not insure the accurate setting of cores, or so that it becomes impossible to set cores except in the correct way. Their shapes and proportions vary greatly. Cores may fill up their print impressions absolutely, or the molder may have to complete the filling up. Prints are carried on patterns only, or in cores, or partly on patterns and partly in cores, and the positions of cores may be entirely indicated by their prints, or only partially, or in some cases prints may be omitted entirely.

Vertical and Horizontal Core Prints.

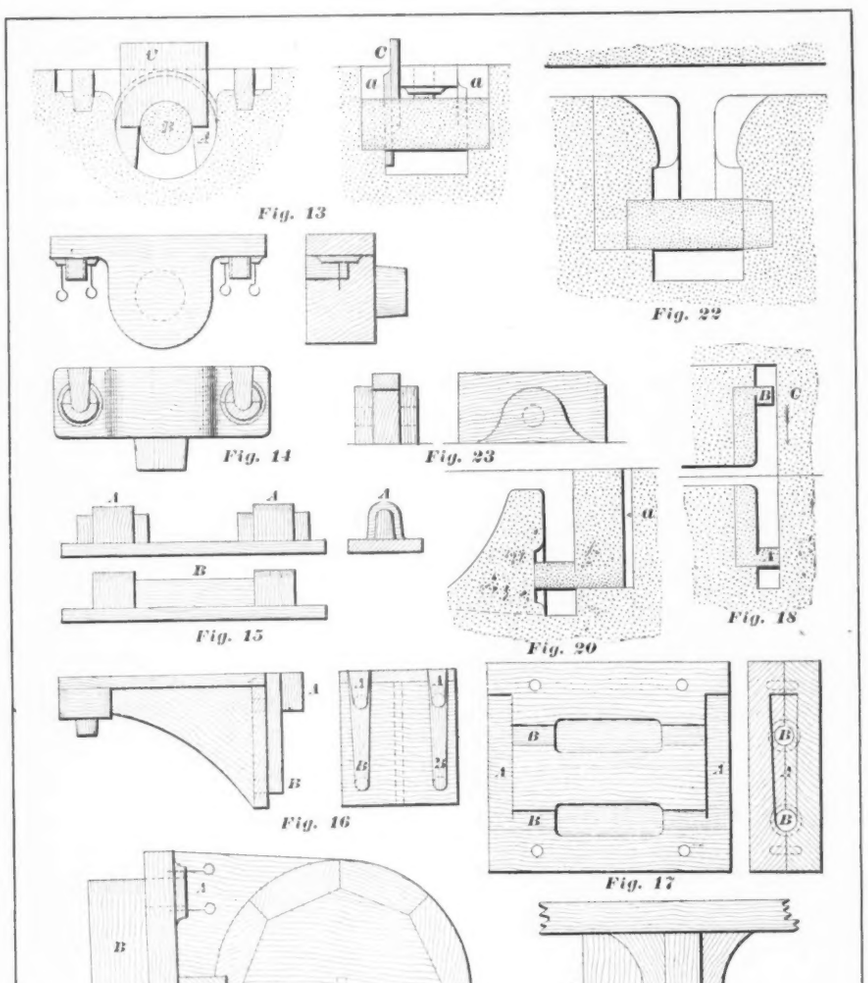
Core prints may be classified broadly into two groups, vertical and horizontal.



Cores which stand at an angle will fall into either classification according to their approximation to the vertical or horizontal position.

Vertical Core Prints.

Taking the familiar pattern in Fig. 1, the prints *A* and *B* are in bottom and top respectively; *A* is longer than *B* and is usually tapered less. The reason of this difference is seen in the mold section Fig. 2. The core stands in and is supported by the lower print impression, hence depth is required. The top print simply prevents risk of movement of the core at that point, and it might be less than is shown. Often the top print is omitted, invariably so in shallow molds. If for any reason a top print is undesirable in a deep mold then the bottom one must be made extra deep to carry the core upright. As there is often a risk of the sand in the top mold becoming crushed on being lowered over cores, an extra quantity of taper is frequently imparted, as in Fig. 3. The core is then steadied by an annulus of sand only, as at *a*. There is thus no arbitrary rule for the proportions of prints. They are merely made of dimensions which will insure steady support to the cores. The larger the area of the cores and the shallower they are, the thinner are the prints made. In very large cores they may not be more than ½ or ¾ inch thick, and in some cases, prints are frequently omitted, and the cores set in the mold by measurement and by gage strips.



Horizontal Core Prints.

In the other great group of prints, the horizontal, the conditions are different. Fig. 4 is typical of this group. As a rule, cores laid horizontally must be supported at both ends. The prints are parallel, and the only rule which governs their length is that they shall have enough area to sustain the weight of the core without the edges of the sand being broken away. Sometimes a radius is imparted next to the pattern, as in Fig. 5, to prevent this risk, and to lessen risk of fracture during delivery. (In all the sketches given it will be understood that the proportions suitable for each case are drawn correctly.)

The pattern is jointed along the center in Fig. 4, and therefore round prints are properly used. But when the joint is elsewhere than at the center, as in Fig. 6, where it is along the face *aa*, the pocket or drop prints, *AA*, are used. The lower portion alone corresponds with the shape of the core, and the portion above has to be filled up or stopped-over. These prints occur in all dimensions, and those of considerable depth are rather awkward for stopping-over. But the only alternative is to joint down to the center as indicated by the dotted lines in Fig. 7, which would be more awkward than stopping-over, though often, when the position of the prints is complicated by other details, it has to be done. Made as in Fig. 6, the method of stopping-over is as shown in Fig. 8. The core *A* has been laid in place, and the stopping-over piece *B*, cut to fit the core, is laid against each inner face of the mold in turn and the sand rammed in at *aa*. When molds are made in quantity, this labor is avoided by making a core box, as in Fig. 9, to stop the core over. The core made from it is seen in Fig. 10. It cores the hole and fills up the print impressions at once.

Intricate Horizontal Cores.

It is obvious that the presence of bosses or facing pieces must complicate the stopping-over. Thus, in Fig. 11, the boss *A* is either cut to fit around the print *B*, or the print is shouldered back to allow a solid boss to pass between it and the face of the pattern. A core box should be made in such a case, Fig. 12, in which the portion *A* of the boss that comes behind the joint is put in the box. But if stopped-over as in Fig. 13, a loose boss is cut at *A* to fit over the core *B*, and the portions of the print impression at *aa* are made good over the boss against the stopping-over piece *C*.

Pocket Prints.

When holes occur in directions at right angles with each other, then round and pocket prints are both used as in Fig. 14. But it is generally preferable to avoid the stopping-over against the bosses in Fig. 14 with the marks that are left on the casting, and to use round prints on bosses, and pocket prints on the plane faces as in Fig. 6.

When portions which have to be cored horizontally are situated some distance apart, the prints may be put on each side of each portion, as on the lugs *AA*, Fig. 15, or one long print *B* may extend from lug to lug, as in the lower illustration. The latter insures a more accurate core-setting. The same device is adopted in round and square cores under similar conditions.

Superimposed Prints.

When holes occur over one another and pocket prints are used, the prints are superimposed, Fig. 16. As the amount of overhang of the upper core is greater than that of the lower, the prints are made thicker, as seen at *A*. This is a case where stopping-over had better be done in the core itself, but then the print *A* is unnecessary. The print *B* will carry both cores.

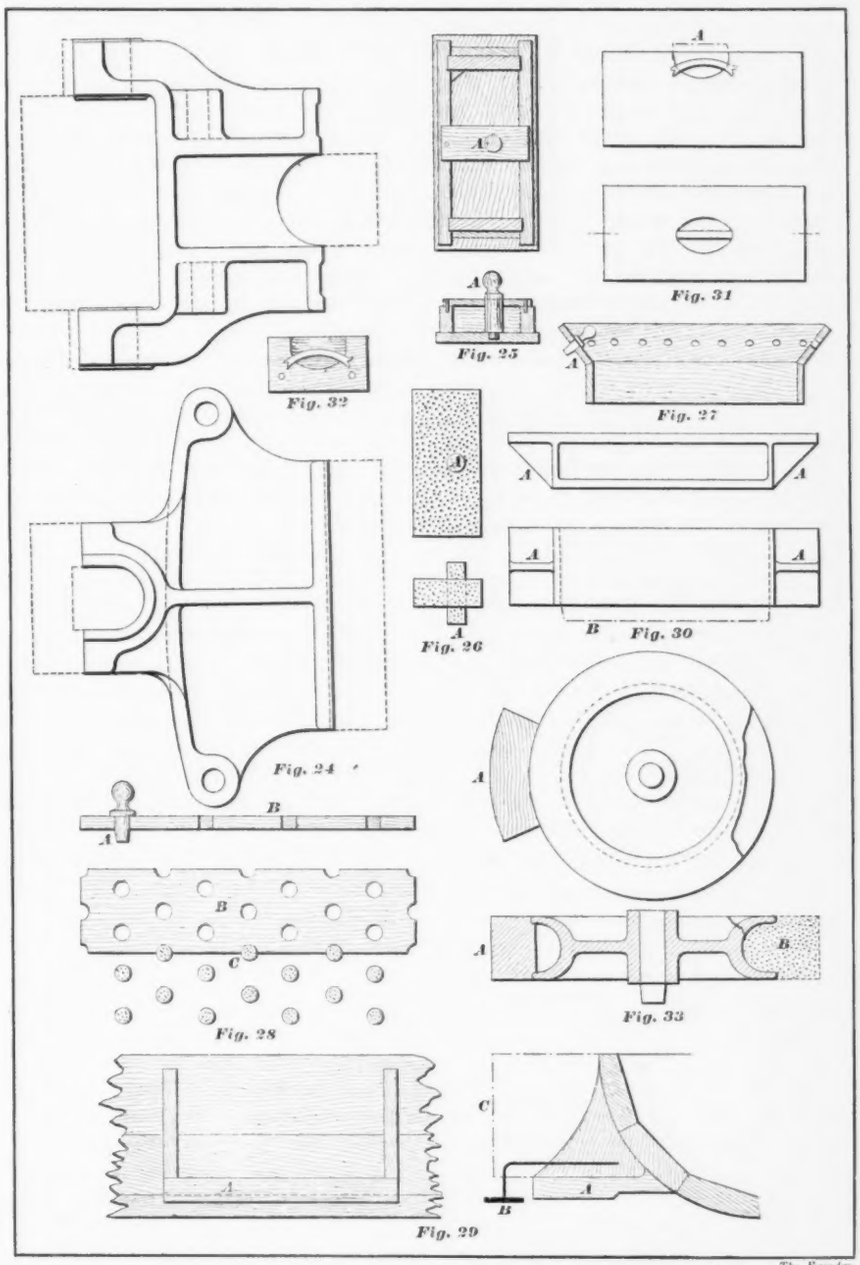
Fig. 17 illustrates a special application of the method of making one pocket print core out of two sets of holes, one above the other. If a casting has to be cored out with two long holes, one above the other, these are taken out by means of two pocket prints, one on each face of the pattern. The core box is seen in end view, and in the joint face, in Fig. 17. The holes are cored and the prints stopped over with one core. In Fig. 17, *AA* are the portions that correspond with the pocket prints, and *BB* are the holes.

Prints in Top and Bottom of a Mold.

When prints are used in top and bottom of a divided mold and the cores are made to stop themselves off, a slight difference must be made when putting them in the bottom, and in the top. In the bottom the cores fit tightly endwise, *A*, Fig. 18. In the top they must not be quite of their full length, *B*, or they are almost certain to be broken, or else to crush the top sand *C* as it is being lowered. This leaves a little blank metal on the face of the casting beyond the core, but that is of no consequence, since it is readily knocked through with a hammer and a drift pin. When cores are inserted without prints, by means of a templet, those in top and bottom fit tightly.

In Fig. 19, boss facings *AA* are cast on the inside of feet through which holes are cored. The prints *BB* are made sufficiently thick to permit the cores to be pushed along after being lowered, as shown in Fig. 20, leaving a space behind at *a*, which is filled up subsequently with sand.

There is one advantage in making cores in special boxes to stop themselves over, besides that of saving the trouble of ramming sand over the cores in the print impression. It is this—that the cored holes will generally be more accurate when made in this way. When short round cores are lowered down into the bottoms of pocket prints they are very likely to drop a little, either in consequence of the end of the print not being cut truly, or by reason of a slack fit in their print impressions; or they may be set truly, but become shifted during the stopping-over. The ideal print is of course one that completely encircles the corresponding end of its core, and the convex end of a pocket print does not fulfill this condition, hence the desirability of making the core so that its correct position is secured.



Depth of Pocket Prints.

In the illlustrations of pocket prints given, none of the prints is of very great depth. It is not good practice to make them very deep, because they cause much trouble to the molder and are sometimes the cause of wasters. It is easy to put a drop print, say 12 or 18 inches deep, on the face of a pattern flange or foot, but it is awkward for the molder, who has to lower down and stoop over the core in a space of only 1¼-inch thickness, and perhaps be bending over the work on his knees, holding a torch in one hand. When such deep prints are necessary, the core box should be made to stop the print. Molders sometimes have to carry away a deep face on a draw-back plate, solely for convenience of insertion of cores. In that case, round prints are better than pocket prints; but in such work, unless the quantities of castings required are large, it is cheaper to drill small holes than to core them.

The method of stopping-over bosses

which are cast on the same faces as their pocket prints, Fig. 13, does not apply in the case of bosses located on faces opposite to those which carry the prints. Thus in Fig. 21, the plated portion of a large pattern, molded flatwise, has upon it a boss cast downward. This boss is divided in the pattern in two thicknesses, *A* and *B*, on each side of the middle web *C*. In this case, the bosses *A* and *B* are a little thinner than *C*, and they can be drawn back into the space left by *C*. If they were thicker than *C* then another way of molding would be necessary. In this instance the total width *a* would be rather too great to bridge safely with a core carried by one pocket print only, because the core would be liable to tip. A round print *E* is therefore skewered on *A*. The print *D* is made about twice as thick as *E* is long. The round core is dropped down into the impression left by *D* and pushed along into *E*, the boss *B* inserted and stopped-over in the manner described with reference to Fig. 13, and the supplementary impression of the print *D* filled up with sand behind the core. Fig. 22 is a section through the finished mold.

The reason for making the thickness of the print D about twice that of the length of *E* is obvious from Fig. 22. If *D* were of the same thickness as the length of *E*, the core would lose its bearing in *D*, when slid along into *E*, but the extra length given to *D* affords sufficient bearing for the core after it is pushed into *E*. Many examples of this general method of core-setting could be given but this is sufficient.

In Fig. 21 the thicknesses of *A* and *B* are not much less than that of the web *C*, into the impression of which they have to be drawn. If the entire bracket had been much deeper, and the bosses in consequence lying deeper in the mold, they could not be drawn out at all. As it is, Fig. 21 marks about the limit at which bosses can be withdrawn, and then plenty of taper must be given them, and the molder must thrust in the pricker carefully and deeply, and lift them at a suitable angle. If the bosses were thicker, or lower down in the mold, then it would be necessary to use cores to form the mold above their center planes. This is often done.

In the illustrations of pocket prints the cores are round, but obviously the method is applicable to any form of core, square, rectangular, elliptical, etc. In such cases, it is well to mark the precise shape of the core on the face of the print when the shape would not otherwise be clear. Square and oblong, rectangular cores might be confounded in the absence of a core box, or if there were cores of two kinds on one pattern, as for instance rectangular pocket prints on the face of an angle plate pattern, some of the slot holes being longer than others, the prints on the ends of some slide valves for elliptical holes might readily be mistaken for prints for round holes, and so on.

Cores in Place of Green Sand.

Cores are frequently used in order to insure a clean casting in a narrow space where green sand would be liable to become broken up. It is generally done in the case of lugs, Fig. 23, cast on columns or plates in preference to fastening the lugs alone as separate pieces. Made as in Fig. 23, the lugs and print are screwed together. Another example is given in Fig. 24, which shows how the pattern of the casting of the double bracket would be made with provision for coring out the spaces, the prints being indicated by dotted lines, the pattern molding sideways. The shapes of the core boxes are rectangular, and need not be illustrated.

The question of coring or of self-delivery, when it is a question only of the relation of diameter or of width to depth, is readily settled by practical knowledge. One cannot put anything of this kind into a formula or into set dimensions. It is easy to see at a glance when one method is more suitable than the other, and there are also many cases in which either method would be equally suitable from the point of view of delivery merely, but in which one method would be adopted in preference to the other for special reasons.

Inserting One Core Into Another.

A simple case of the insertion of one core within another is shown in Figs. 25 and 26. Fig. 25 is the core box for the lugs in Fig. 23. The rectangular portion corresponds in dimensions with those of the print in Fig. 23. The round holes are made by a separate core, which is thrust through a hole in the main core made by the pin *A*, Fig. 25. The round core is shown at *A*, Fig. 26, thrust through the main core, and its length is equal to the width over the faces of the lugs in Fig. 23. There are, therefore, no prints on the lugs to indicate the presence of the round cores. If however in Fig. 23 the lugs were very thick, pocket prints would be necessary on the outer faces to prevent risk of the cores dropping slightly. To prevent risk of the core being turned upside down a corner is cut off the print, and a corresponding corner fitted in the box as shown. These devices of fitting cores into another core and of making a register on prints and cores to prevent risk of inaccurate insertion are very common.

Print Impressions in a Concrete Mixer Mold.

Print impressions are in some cases made without fastening prints to patterns. Fig. 27 shows the pattern of a hopper base for a concrete mixer requiring diagonal holes to which the sheet iron flaring extension is riveted. Prints standing out at an angle would not deliver. The plug therefore, seen at *A*, is thrust through each hole in succession, forming a print impression for each core in the mold.

Fig. 28 is an example of work in which a mold of a boiler-maker's bending block has been made by means of an open skeleton frame on a levelled bed. The print impressions are made by the plug *A* thrust down through holes in the templet *B*, which is moved over the bed and reset as often as necessary by a row of the cores as seen at *C*.

Cores Instead of Draw-Backs.

In a great number of instances, cores afford an alternative to draw-backs. Fig. 29 is an example. The foot *A* might be made to deliver back into the mold space if the facing were made loose to follow after. But the width is too great to permit of doing this properly. The practical choice therefore lies between a draw-back plate *B* laid outside the edge of *A* and having rods overhanging to carry the sand above *A*, and the alternative of a core of the shape indicated at *C*, for which a print would be necessary. Generally, the dimensions of the piece of work would determine the choice. A pattern of small or moderate dimensions would be better cored. For one of large size a draw-back would be preferable.

Coring is often adopted in preference to cutting a pattern like its casting, either to make a stronger pattern, or a more accurate casting, or both. Fig. 30 is a typical case. If this pattern were made to deliver its own interior, the brackets *AA* would give trouble. They could not be drawn inside unless the central body of sand were lifted away on a plate. Jointing down to the faces of the brackets would result in fracture of the sand. The best plan therefore is to core the interior, using a print outlined at *B*.

Coring-Out.

Coring-out is adopted in some large plated work in which the cutting out of

spaces in the pattern would weaken the plate, and in which the locking together of arms or ribs would involve considerable labor without conducing greatly to strength, the advantage of locking being the prevention of shrinkage, which can be equally well effected by making open joints. Speaking generally, it is always better to core out light, plated work having crossing ribs, than to cut it out. Many examples might be given, but the principle is sufficiently obvious without illustrations.

Although it may be practicable to let many holes deliver themselves, it is not always judicious to do so, and for several reasons. In such a matter the intuition of the practical man comes in. In cases where a few castings only are wanted it seldom pays to cut out holes. Such cutting would take longer than the putting on of prints and the making of small cores, both of which cost a mere trifle. When large numbers of castings from the same pattern are required, and especially when metal patterns are used, then it often pays to cut out the holes and let them deliver themselves. But when centers and sizes of holes have to be altered from time to time, then they should never be cut out. Again, in many wood patterns, cutting out the holes would weaken them too much. So that even though it may be practicable to let them deliver themselves, holes of small and moderate size are usually formed with dried cores inserted in core print impressions.

Core prints are often used as a convenient method of casting wrought iron handles in flasks, and eyes in weights. Fig. 31 shows a casting of a weight with a wrought iron eye cast in. The eye is put in with a core, the print being indicated at *A*. The core box is shown in Fig. 32, opened in the joint face, with the eye laid in recesses cut in the box to retain it in place during the ramming up. After the core has been knocked out of the casting, the ends of the eye which enter into the sides of the core box are embedded in the metal of the casting. The swivels and handles of flasks are fitted in pocket prints. Shafts are sometimes cast in rollers in round prints.

Broken Castings and Patterns.

When broken castings have to be molded from, prints are fitted in some cases to avoid making a new wooden pattern. Thus, the broken sheave pulley in Fig. 33 will deliver on the outer faces but not in the groove. A print *A* can be worked round, and sand rammed on the outside of it to form a ring print encircling the mold. Segmental cores made in a box of the section indicated at *B* will form the groove.

A great deal of work is cored, not because coring is altogether necessary, but because it is convenient. In this, as in a good deal of pattern and foundry work, it is a question of alternative methods. One is not right and the other wrong, but one is better than the other. It is better, either because it is cheaper, or it insures a more creditable job, or it saves unnecessary trouble. The settlement as to which is the best method often involves much consideration on the part of the workman and foreman, because so many matters of detail have to be considered in carrying the work right through.

AN EMERGENCY STEEL CASTING JOB

BY H. J. McCASLIN

WHILE not advocating the method of molding pursued in this case if more than one casting is to be made from a pattern, it nevertheless can be followed to advantage in emergencies, and if only one casting is to be made. A part pattern such as is used on this job, not only reduces the amount of lumber required, but also cuts pattern shop labor costs, and is a material factor in insuring the early delivery of the casting. If this work is carefully done it will permit of the delivery of a 4 to 5-foot, double groove, cast steel sheave, similar to the one shown in Fig. 1, within four days after beginning work on the pattern. This time allowance gives the patternmaker one day for the delivery of the core boxes, and with the exception of the box for the arm cores, the groove, bore and covering core frames can be delivered to the foundry before the noon hour, if work is commenced in the morning. Not more than 48 feet of material will be required, and the pattern shop labor will not exceed 24 hours. On the other hand, complete patterns for sheaves of this size and type, with a groove core box, will require approximately 150 feet of lumber and 50 hours of pattern shop labor.

Reduction in Pattern Shop Cost.

It is a case of saving the pattern shop at the expense of the foundry, for if a complete pattern is furnished, a molder can easily complete a mold of this size, ready for drying, in seven hours. As approximately the same time is required in arranging the cores, regardless of whether a part or complete pattern is used, the foundry expense on this job was increased 16 hours, which represents the time required in making the 12 half arm cores and the covering core. As against this increased foundry labor, a saving was effected in the pattern

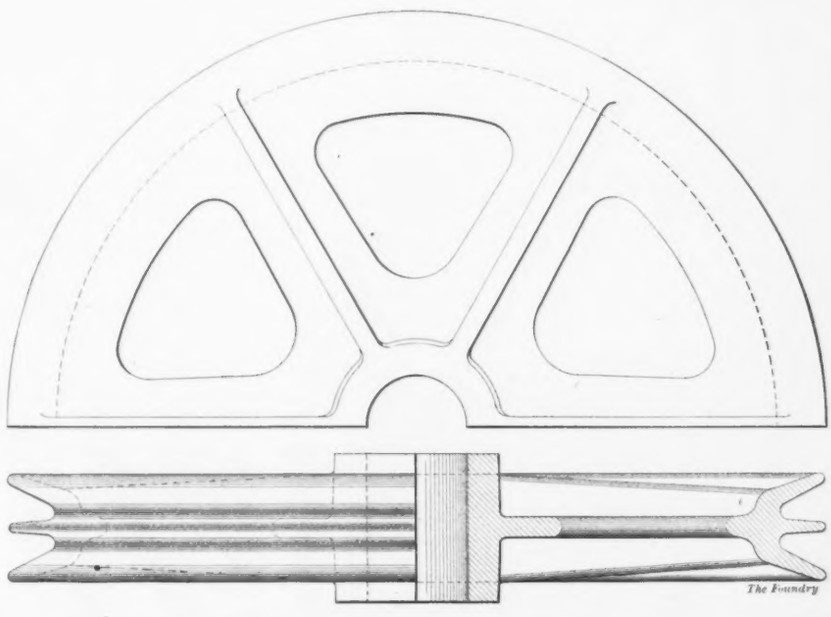


FIG. 1—HALF PLAN, HALF ELEVATION AND RADIAL SECTION OF DOUBLE GROOVE, CAST STEEL SHEAVE

shop of 100 feet of lumber and 26 hours labor.

The Sheave Pattern.

The sheave is shown in half plan, half elevation and radial section in Fig. 1, and Fig. 2 is a plan and sectional view of the core box used for the six bottom and top cores. With the exception of the web *A*, Fig. 2, which is attached to the bottom board, the hub, rim and print material, *B*, *C*, *D*, and the rib *E*, are made loose. These parts, as well as the frame, may be secured to the bottom board, but if made loose, they will prove of convenience to the coremaker, and will greatly facilitate future alterations to the box. Material *F F* is placed upon each side of the box to minimize the contacting surfaces of the opposite cores, and if made as large as consistent with safety, it is obvious that less time will be required in assembling the cores, especially if the wheels are of large diameter. The only difference in the bottom and top cores is that three of the latter are provided with riser openings formed by a block at *G*, and an opposite bottom and top core with an opening for the gate made by ramming up the pin at *H*.

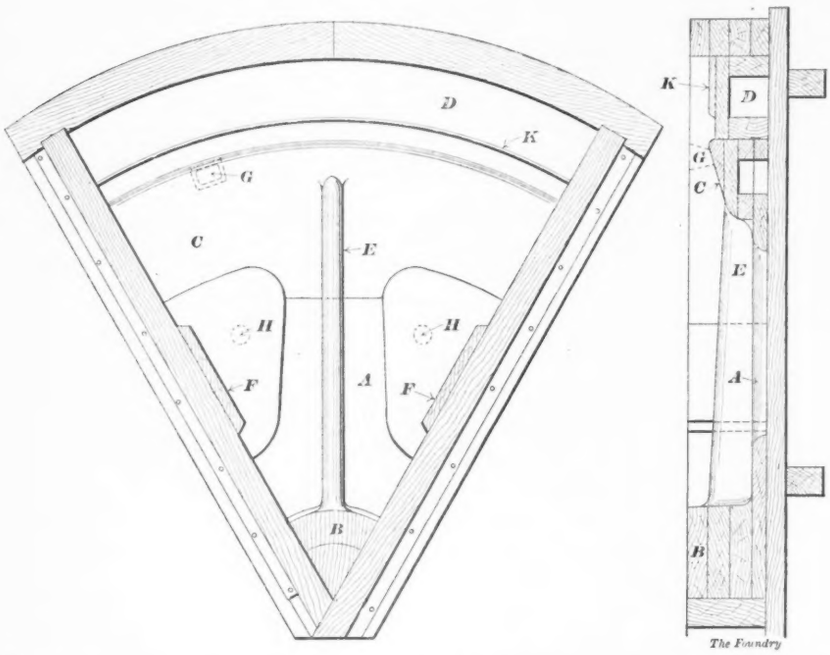


FIG. 2—PLAN AND SECTIONAL VIEWS OF CORE BOX FOR THE SIX BOTTOM AND TOP CORES

Core Box for Groove Cores.

Fig. 3 shows two views of the core box, for the eight groove cores, as well as the strike used in forming the grooves at the top of the core, the ends of the frame being cut out as shown. It will be noted that instead of making the outside of these cores conform to the outside diameter of the arm cores, they are made flat at *I* to facilitate the coremaking and drying operations. To each side of the frame are attached the strips or segments, *J J*, which form upon the cores, corresponding offsets to those formed upon the arm cores by the material *K*, Fig. 2, for the correct location of the former cores between or opposite the arm cores, as shown in the sectional view of the mold, Fig. 6.

When making a box for a rough or cast groove sheave, I would recommend the forming of the grooves at the bottom of the box. This job can be simplified by joining the material at the center of the groove and laying out its contour upon each radial end. The material is then taken apart and roughed out upon a circular saw. However, for a finished sheave, as in this case, the method pursued is satisfactory.

Fig. 4 shows the core print used for forming a seat for the bore core and the concentric location of the bottom arm cores. Fig. 5 is the core box used in making the covering core, which encircles the bore core and also closes the top of the mold.

The Mold.

A radial section of the completed mold and a similar section with the bottom arm cores in place, are shown in Fig. 6. The molding operation is begun by striking up a surface or seat with two straight edges, at the center of which the gate is arranged and the core print *L* is bedded-in, as shown. Abutting the upper part of this core print, which is equivalent in diameter to that of the hub portion of the mold, the six bottom cores are placed in position. Following the setting of the groove cores, the top arm cores are set in alignment with the bottom halves, and the mold is enclosed with a flask or curbing, firmly backed with sand. The bore and covering cores are next set in position,

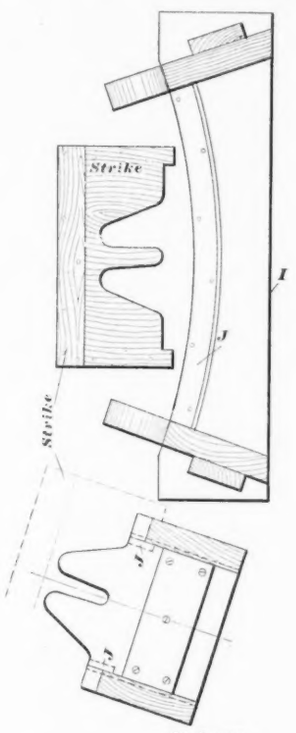


FIG. 3—TWO VIEWS OF THE FRAME FOR THE EIGHT GROOVE CORES, AND THE STRIKE USED FOR FORMING THE GROOVES AT THE TOP OF THE CORE

and after the runner and risers have been built, the mold is weighted and is ready for the metal.

MODERN BRONZES—THEIR CONSTITUTION, PROPERTIES AND USES.

In a lecture on "Modern Bronzes," recently delivered before the Metallurgical Society of Birmingham, Eng., A. H. Hiorns pointed out, that with the growing use of certain metals such as aluminum, the term *bronze*, originally signifying an alloy of copper and tin, had become so extensively misapplied that many alloys now termed bronzes contain no tin. He suggested the use of the term *special bronze* for those alloys of

copper in which tin was not necessarily the predominant metal. Having given an exhaustive account of the researches on copper-tin alloys up to the present time, Mr. Hiorns dwelt upon the importance of quenching as modifying the properties of a bronze, and upon the liability of even the most ductile of these alloys to

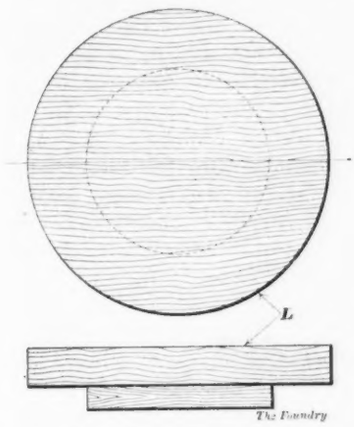


FIG. 4—CORE PRINT FOR FORMING THE SEAT FOR THE BORE CORE

injury by an injudicious working, either under the hammer or on the draw bench. Forging, he said, had a great hardening effect on bronze with consequent brittleness. Under the classification of bronzes he mentioned the alloys in which lead is used, and which serve for anti-friction bearings. Bronzes for statuary, while consisting chiefly of copper, also contain zinc and frequently lead. Speaking generally, of bronzes with zinc, the lecturer said that in small quantities, zinc produces a better casting and one more free from blow-holes as it acts as a deoxidizer in forming oxide of zinc. The tenacity and elastic limits are clearly raised by the addition of zinc, not exceeding 2 per cent, but above that there is a diminution of tenacity and hardness. In bronzes with lead, Charpy discovered by oblique illumination, that the black patches contain small blow-holes bordered with small crystals of lead. This might be explained by the partial volatilization of the lead in the midst of the alloy, and is intensified by casting at a high temperature. This alloy, therefore, should be cast at a minimum temperature. With much lead, liquation takes place, since the lead remains liquid until about 330 degrees Cent., and has a tendency to fall in the mass in virtue of its great density. The best results for bearings have been obtained from an alloy of copper 84, tin 8, lead 8. Hendrickson and Clamer, in America, found that nickel possesses the remarkable property of preventing the liquation of lead in bronze, and these alloys are largely used in America and in France by the railroads with excellent results. The usual composition is, copper 64, lead 30, tin 5, nickel 1.

Discussing phosphor bronze, the speaker said that when cast at too high a temperature there can be seen issuing from the top of the casting and in the gate, liquid, worm-like filaments, solidifying in the form of mushrooms. In them, the phosphorus and tin are in greater proportion than in the main body of the alloy. The properties of phosphor bronze are similar to those of ordinary bronze. Some phosphor bronzes contain zinc or lead. Manganese bronze must not be confronted with brass containing manganese, nor with cupro-manganese. Manganese bronze consists of copper, tin and manganese, though it is but little used. A small amount of manganese increases the tenacity and elongation, but it is not advisable to use more than 1 per cent. The same results can be obtained with a small amount of phosphorus. Bronzes have also been employed containing both manganese and phosphorus. The following composition has been recommended for propellers: Cupro-manganese 92, tin 5, zinc 3, and manganese 0.5, with a trace of phosphorus. Silicon bronze is valuable for electrical purposes on account of its resistance to corrosion. A bronze with 89 copper, 9 tin, 1.5 zinc, 0.5 lead, and a trace of silicon, showed a tensile strength of 34,400 pounds per square inch, with

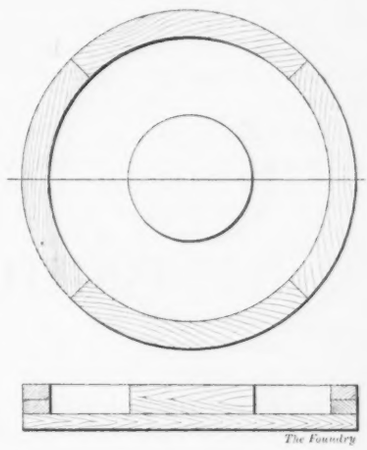


FIG. 5—CORE BOX FOR THE COVERING CORE, WHICH ENCIRCLES THE BORE CORE AND CLOSES THE TOP OF THE MOLD

an elongation of 40 per cent. There are bronzes containing aluminum which must not be confounded with aluminum bronzes, the latter consisting of copper and aluminum. The true bronzes with aluminum should contain only very small quantities of the latter, just sufficient to reduce the oxides in copper-tin alloys. Aluminum has a greater strengthening effect than silicon, but except in very small quantities is deleterious in copper-tin alloys. The aluminum bronzes are manufactured in different grades by varying the aluminum. Mr. Hiorns added that commercial aluminum bronzes might be divided into two groups, namely, those with zero to 7.35 per cent copper and those with 7.35 to 10 per cent copper.

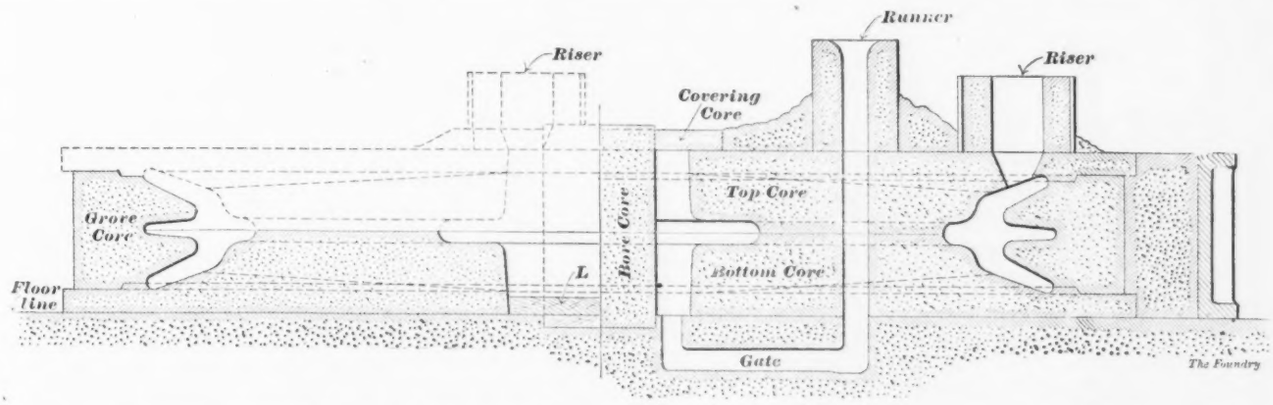


FIG. 6—RADIAL SECTION OF FINISHED MOLD, AND A SIMILAR SECTION WITH ONLY THE BOTTOM ARM CORES IN PLACE

THE CONTINUOUS OPERATION OF A SMALL CUPOLA.

By W. J. Keep

Question:—How long do you consider that a cupola, which will bring down two tons of iron per hour, can be operated without becoming so slagged up that it will be impossible to get good iron from it? We would also like to have you suggest methods by which the time could be increased beyond that possible by ordinary practice.

Answer:—Run with a soft blast, say 6 ounces, and charge very pure limestone or oyster shells, so as to keep up a constant running stream of liquid slag. In this way you can run continuously. If you will visit a foundry where they make iron beds you will find that they run a very small quantity of iron continuously. The tuyeres are placed quite a distance above the bottom, and the cost of the fuel consumption is of small importance. Never permit slag to get near the tuyeres, and run with a soft blast so as to keep the coke at the tuyeres red. The slag should be kept fluid throughout the entire heat, and should be constantly drained off.

THE INSTITUTE OF METALS

THE annual meeting of the Institute of Metals was held Jan. 18 and 19 in London, Eng. The report of the council showed an increase of membership from 355 to 505, and the financial report was particularly gratifying.

In his presidential address, Sir Gerard Muntz called attention to the fact that much of the knowledge, ancient and modern, bearing upon the treatment of non-ferrous metals, needs collecting and codifying. "Another matter, which requires investigation," he added, "is the cause of corrosion of non-ferrous metals, especially copper and the copper alloys, by sea water. This corrosion is the cause of perpetual trouble to engineers and users of such metals." Continuing he said:

"The multiplicity of alloys specified as manganese, bronze and gun metal, and the variety of tests specified for them is amusing. Mechanical tests are almost always given without any corresponding chemical tests, generally without even an analysis. Gun metals, such as are supplied commonly, are often not gun metals at all, but merely some form of brass. The tests specified would in themselves prevent gun metal being furnished. Gun metal is occasionally specified to stand hot forging. No true gun metal can be treated in this way, so it stands to reason that the makers must of necessity supply something different. Quite probably it is as suitable for the purpose it is required for as gun metal would be, but it is not gun metal. Its acceptance as such is only misleading to all concerned. It is evident that the general knowledge of the non-ferrous metals is simply appalling by its absence. It leaves a greater scope for the work of the Institute of Metals."

Study of Phosphor-Bronze.

"A Contribution to the Study of Phosphor-Bronze," was the subject of a paper presented by O. F. Hudson and E. F. Law. The authors sought to indicate the relation between the mechanical and other properties of the copper-tin-phosphorus alloys and their constitution and structure. A diagram was given showing the constitution of all the alloys containing up to 25 per cent of tin. For practical purposes the phosphor bronzes, it was stated, may be divided into two classes, (1) the malleable phosphor bronze containing relatively small amounts of tin and phosphorus, not more than about 6 per cent of tin and 0.3 per cent of phosphorus, and (2) the cast phosphor bronzes containing in some cases as much as 12 per cent of tin and 1.5 per cent of phosphorus. The paper was illustrated by a number of micro-photographs illustrating the structure of the alloys.

Copper-Arsenic Alloys.

Guy D. Benough and B. P. Hill presented a paper entitled "The Properties and Constitution of Copper-Arsenic Alloys." This paper dealt, first with the mechanical properties of the alloys of industrial importance, and second, with their chemical constitution. The authors stated the most important purposes for which these alloys are used are for locomotive parts and dynamo brushes. The peculiar characteristics of the alloys as compared with pure copper are greater strength and rigidity, and greater resistance to the action of gases at high temperatures. The best proportion of arsenic to be used to insure the maxima of the advantages named, was shown to be a question upon which opinions differ widely. The best percentage of arsenic to use in the alloys tested by the authors was found to be in quantities less than 2 per cent. This has a tendency to increase slightly the tensile strength and elongation of the metal. The authors were also of the opinion that the homogeneity and the resistance to the action of reducing gases increase with increased percentage of arsenic up to 2 per cent.

Other papers presented at this meeting were as follows: "The Analysis of Aluminum and Its Alloys," by Dr. R. Seligman; "The Failure in Practice of Non-Ferrous Metals and Alloys with Practical Reference to Brass Locomotive Tubes," by T. Vaughan Hughes; "Assay of Industrial Gold Alloys," by Ernest A. Smith, and "The Use of Carbonaceous Filters in the Smelting of Zinc, as Employed in the Hopkins Fumeless Zinc Process," by C. O. Bannister.

A dinner was held on the evening of the first day at the Criterion restaurant, which was attended by nearly 200 members and guests.

LARGE MARINE CASTINGS.

According to *The Engineer*, London, some of the steel castings which will be used in the construction of the steamships Olympic and Titanic, which are now being built by Harland & Wolff, Ltd., for the White Star lines, are among the largest and heaviest marine castings ever produced. The total weight of the stern frame, rudder and brackets in each of these steamships will be approximately 289 tons, made up as follows: Stern frame, 70 tons; after boss arms, 74 tons; forward boss arms, 45 tons, and rudder, 100 tons. The stern frame is of special quality, mild steel and is of hollow or dished section, constructed in two sections, 63 feet and 37 feet 4 inches in length, respectively. In casting the main piece of the stern frame about 95 tons of molten metal were required.

AN ALUMINUM SOLDER.

Zoltan Tomassy, Cleveland, has recently patented a new composition for soldering aluminum which has the following ingredients: Zinc 8 ounces, tin 8 ounces, antimony 130 grains, salicylic acid 44 grains. The metals are melted together and the salicylic acid is added last.

TELPHERAGE SYSTEMS FOR FOUNDRIES

Modern German methods of handling raw material in foundry storage yards and its conveyance to the cupola

BY ALFRED GRADENWITZ

FOR handling raw materials in foundry storage yards, telpherage systems have been installed in a number of large casting plants in Germany, which have effected great economies in the cost of handling pig iron, coke and limestone, and in most installations the cupolas are charged direct by buckets suspended from overhead tracks. The systems, shown in the accompanying illustrations, were installed by Bleichert & Co., Leipsic, Germany, and are typical of similar installations made at other plants by this concern.

Double Track System.

The system installed at the plant of Thyssen & Co., at Mullheim-on-the-Ruhr, Germany, shown in Figs. 1, 5 and 7, consists of a double track at a height of about 10 feet above the level of the storage yard. As illustrated in Fig. 1, it extends the entire length of the yard, and the buckets suspended from the same, shown in Fig. 5, are at a convenient height for charging limestone, pig iron, coke and scrap. Each bucket contains one charge, and to facilitate the weighing of the material, the trucks from which the buckets are suspended are provided with recording scales. In the storage yard, these trucks operate at a speed of 190 feet per minute, and after the bucket has been filled with a requisite amount of coke, limestone, pig iron and scrap for the charge, it is conveyed to an elevator, which raises it to a level of the charging platform, the truck being held in position on the elevator car by automatic stops. Upon reaching the level of the charging floor, the buckets are conveyed on overhead tracks to the cupolas and are automatically discharged into a chute leading to the charging doors of the furnaces. As shown in the plan view, Fig. 7, another overhead track parallels the discharging track from which storage coke is dumped, as well as limestone, iron, etc., which is used in case of emergency, especially in the event of a breakdown to the yard system. Sand storage bins are also arranged at one side of the charging platform from which the sand is conveyed to the mixing plant located in another section of the foundry. This material is delivered to the charging platform by the telpherage system, which handles the coke, pig iron, etc. After the buckets are discharged, the trucks are returned to the elevator, and after being locked in position the elevator is lowered by the operator, who is located on the ground level. The locking of the truck on the elevator actuates a device, which signals the operator when to lower the car. When the trucks are not in their proper position the elevator cannot be operated. To obviate the possible col-

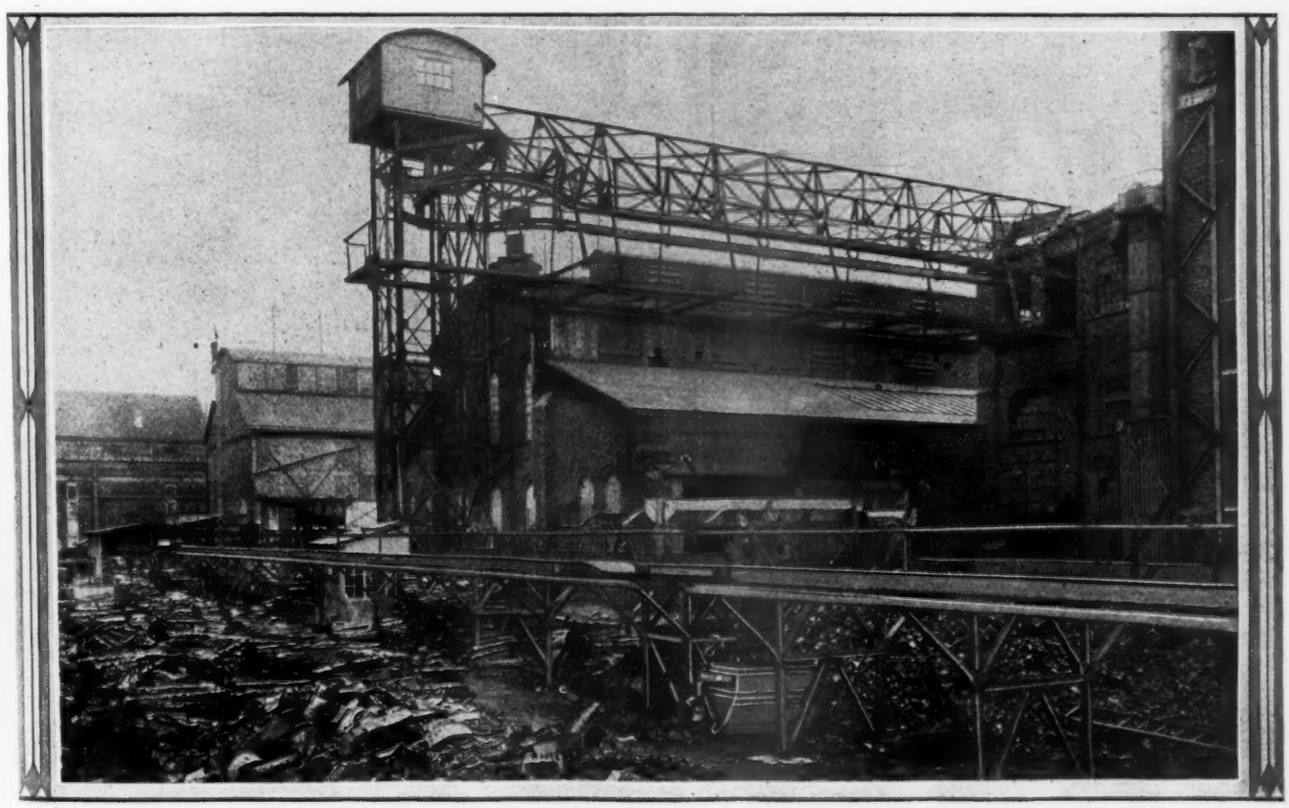


FIG. 1—GENERAL VIEW OF TELPHERAGE SYSTEM AT PLANT OF THYSSEN & CO., MULLHEIM-ON-THE-RUHR, GERMANY

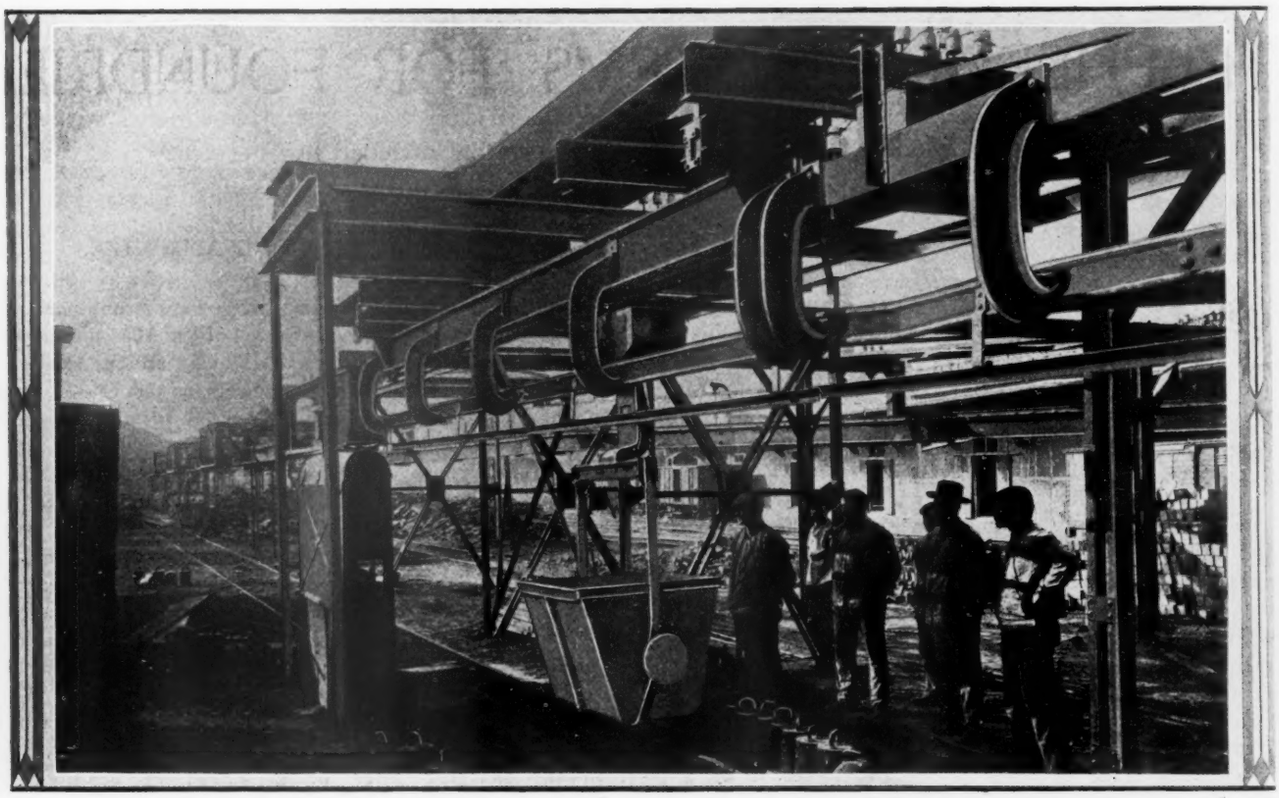


FIG. 2—METHOD OF WEIGHING CUPOLA CHARGES IN TRANSIT AT THE PHOENIX WORKS, HORDE, GERMANY

lision of the trucks with their suspended buckets, switches are provided, which cut out the current from the track section on which an empty bucket is being charged, thereby stopping the approaching truck. In the plan view, Fig. 7, four of these switches are shown, which are also used for conveying the trucks by the shortest route when charged at points near the cupola. This telpherage system serves two cupolas in a foundry having a melt of approximately 48,000 tons per annum, and handles all of the sand used in this shop, which is conveyed

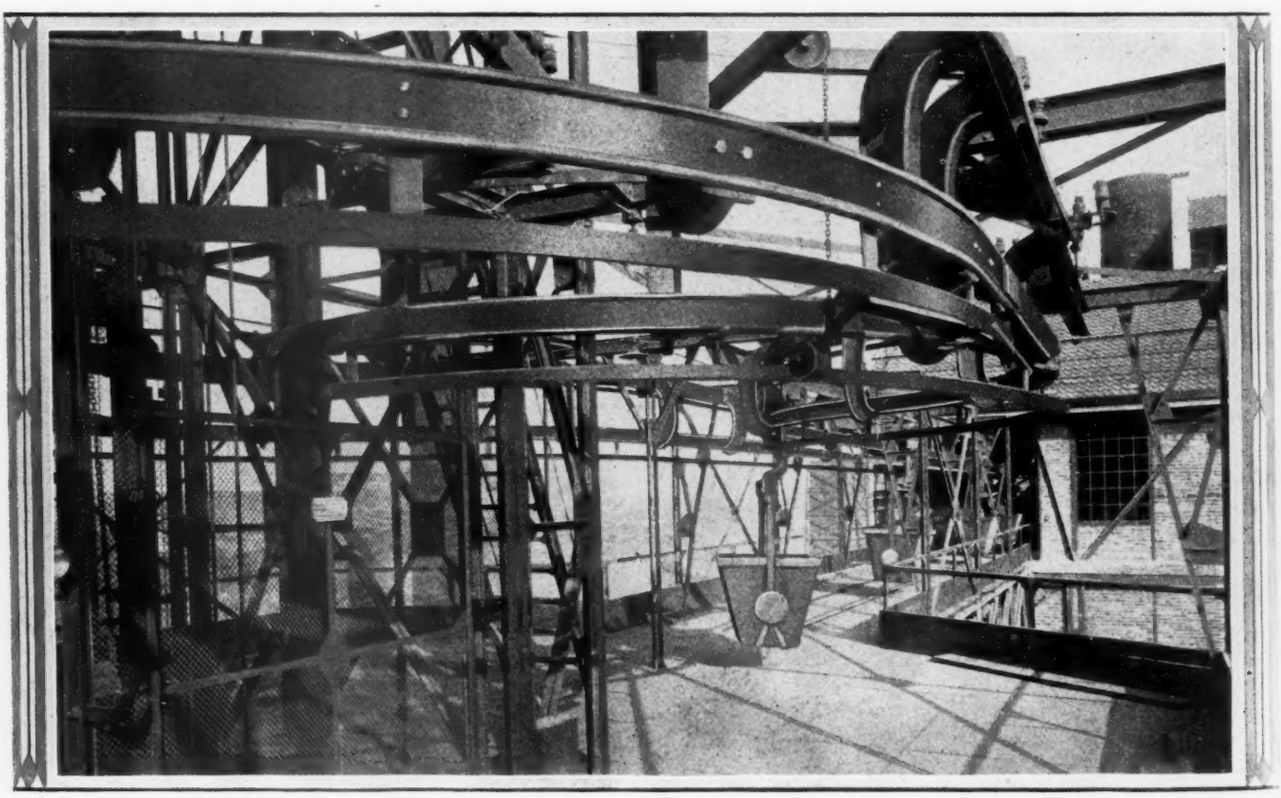


FIG. 3—OVERHEAD TRACKS TO THE CUPOLA, PHOENIX WORKS, HORDE, GERMANY

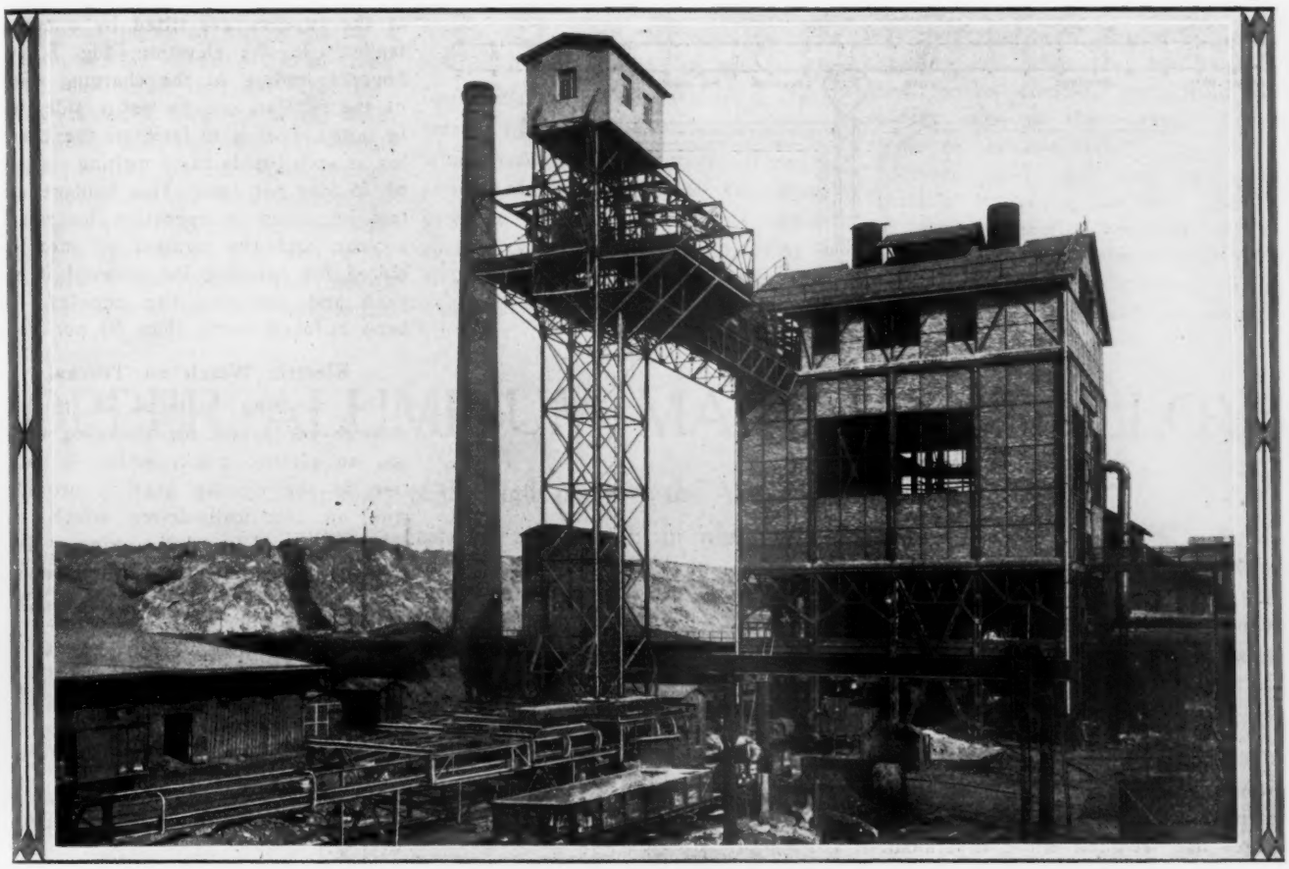


FIG. 4—ELEVATOR WITH TWO CAGES, AND BRIDGE WITH OVERHEAD TRACKS TO CUPOLA HOUSE, PHOENIX WORKS

to the sand bins on the charging floor. A similar system, shown in plan and elevation in Fig. 8, has been installed at the Phoenix Works, Horde, Germany. An overhead track extends the length of the storage yard.

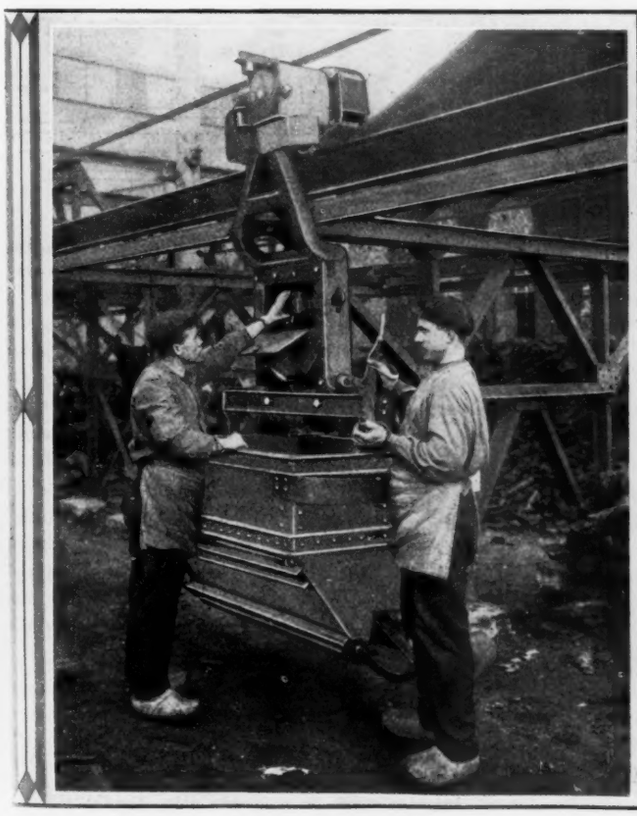


FIG. 5—SCALE TRUCK FROM WHICH CHARGING BUCKET IS SUSPENDED

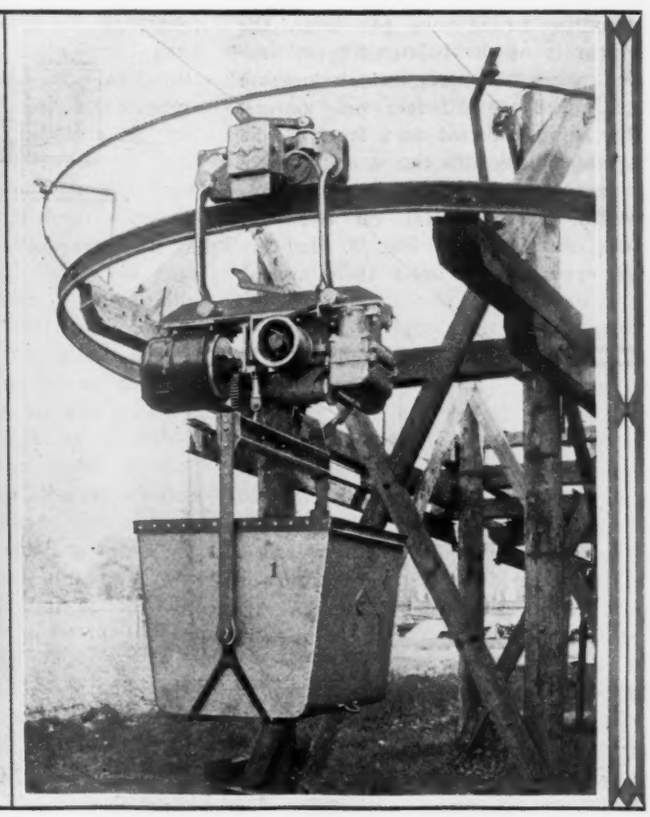


FIG. 6—TRUCK PROVIDED WITH ELECTRICALLY-OPERATED WINCH FOR RAISING AND LOWERING BUCKET

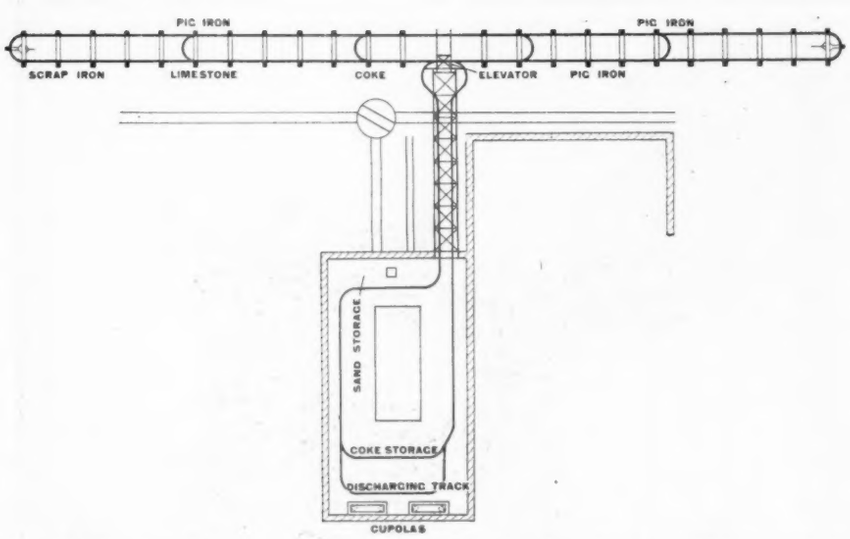


FIG. 7—PLAN OF TELPHERAGE SYSTEM INSTALLED AT THE PLANT OF THYSSEN & CO.

switches being provided at convenient points to permit of the shortest routing of the charging buckets to the elevator and charging floor. The method of weighing the material is, however, somewhat different than that shown in Fig. 5, inasmuch as the charges are weighed while in transit. The scales are shown in Fig. 2, the weigh beam forming a section of the overhead track over which the truck passes. Owing to the large amount of material that must be handled, as the melt is unusually large in this shop, amounting to 52 tons per hour, the elevator is of the balanced type, provided with two cars, which operate at a speed of 190 feet per minute. After being elevated to a level of the charging platform, the trucks leave the cars automatically and are conveyed to the cupolas on overhead tracks, as shown in Fig. 3. In this case, the buckets, upon their arrival at the cupolas, are tilted by a cupola tender. In the elevation, Fig. 8, two hoppers leading to the charging doors of the cupolas, one on either side, will be noted. This is to facilitate the charging as each cupola has a melting capacity of 26 tons per hour. This haulage system has been in operation for nearly a year, and the number of men required for handling the material in the yard and charging the cupolas, has been reduced more than 50 per cent.

Electric Winch on Trucks.

For handling material in foundry storage yards and for charging cupolas, an electric truck, which in addition to the driving gear is provided with an electrically-driven winch, can also be used to advantage. This winch permits of raising and lowering

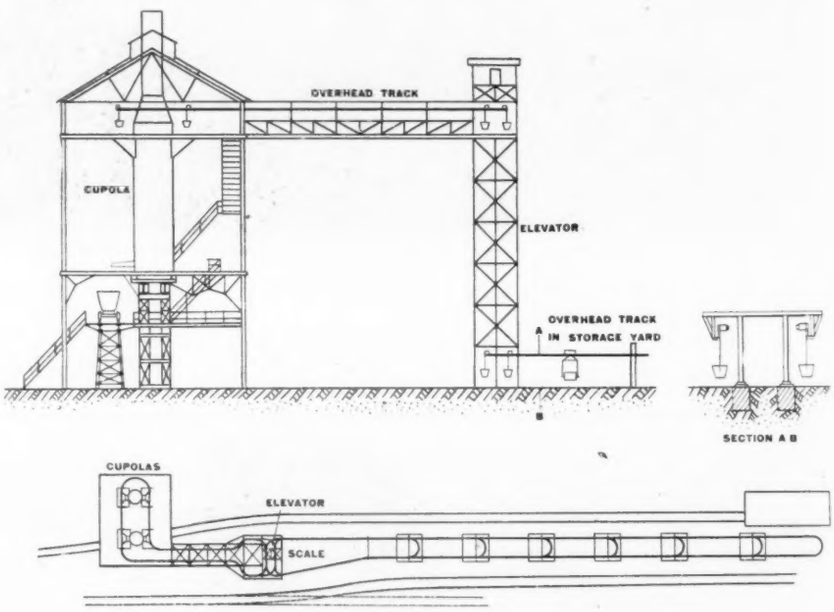


FIG. 8—ELEVATION AND PLAN OF TELPHERAGE SYSTEM INSTALLED AT THE PHOENIX WORKS

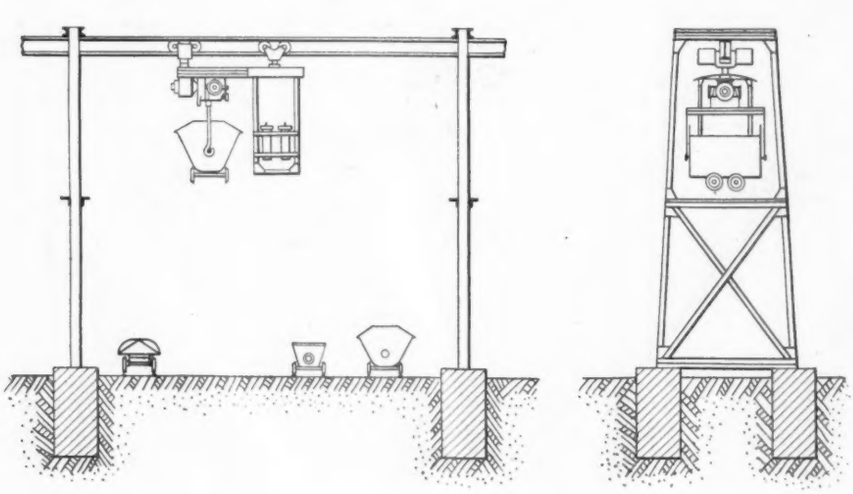


FIG. 9—ELEVATION OF OVERHEAD SYSTEM AT THE STEEL CASTING PLANT OF KRUTHEIM BROS., CHEMNITZ, GERMANY

the buckets at any point in the storage yard, and in addition, an automatic steering device is provided for the remote control of these trucks. The controller, located on the trolley, is actuated by a magnet, which derives its current from a loop conductor. As the order of operations is always the same, the operator throws in the switch key mechanically to turn the starter, thus throwing current into the corresponding section of the working line.

Another Overhead System.

Another system for handling raw material, shown in Fig. 9, has been installed at the steel casting plant of Krutheim Bros., Chemnitz, Germany. The material is charged into cars and after being weighed, is conveyed to

the various parts of the plant by a truck suspended on an overhead track. It will be noted that the operator's cab is suspended from the truck, which is provided with two 4-wheel driving gears operating on the lower flanges of the rails, and the cars are elevated by a winch having two drums actuated by a spur wheel gear and worm. The truck is operated by two motors, and the winch by an independent motor, all of which are enclosed. The controllers and switches are in the operator's cab. The switches are protected by an electric block system, which cuts out the current from the conductors leading from the tracks towards which the switch is opened, thereby eliminating the possibility of running into an open switch. This overhead system is provided, not only for conveying raw material to the charging floor, but also for handling sand, flasks, lumber, etc., from the storage yard to the various departments of the foundry.

Molten iron can also be satisfactorily conveyed in the foundry by overhead trolley systems, and in one plant the iron is conveyed from the cupola to the molding floors at a speed of 260 feet per minute.

COPPER, ALUMINUM, MANGANESE ALLOYS

Summary of the ninth report to the Alloys Research Committee --- Tests of alloys rich in aluminum and copper

THE ninth report to the Alloys Research Committee was recently presented to the Institution of Mechanical Engineers by Dr. W. Rosenhain and F. C. A. H. Lautsberry, of the National Physical Laboratory, Teddington, Eng. The mechanical properties of the alloys of copper and aluminum with manganese lying within the limits of an aluminum content of 11 per cent and a manganese content of 10 per cent, were investigated in the first instance by a series of 22 "exploratory" meltings of approximately 20 pounds each, tensile tests of sand and chill castings of each of these alloys being made. A summary of the report is given herewith.

Alloys Rich in Copper.

The general inference drawn from the results, after detailed discussion, is that the effect of manganese is in most respects similar to that of aluminum itself, but that while larger additions of manganese render the alloy brittle and weak, the first effects of adding small quantities of manganese are to stiffen the alloys, that is, to raise both their yield-points and ultimate strengths without diminishing their ductility. Nine alloys, ranging in manganese content from ½ per cent to 5 per cent, and in aluminum content from 7 to 10 per cent, were selected for preparation on a larger scale and for more complete investigation. Tensile tests on these alloys in the form of sand castings, chill castings, rolled bars of various sizes and cold-drawn bars, gave a series of interesting results, several of the alloys proving themselves superior to any of the binary alloys of copper and aluminum. Thus, in the case of sand castings, one, containing approximately 10 per cent of aluminum and 1 per cent of manganese, showed a yield-point of 14 tons per square inch, an ultimate stress of 35.76 tons per square inch, and an elongation of 22.5 per cent on 2 inches, as compared with the best of the binary alloys, described in the Eighth Report by Messrs. Carpenter and Edwards, which gave a yield-point of 11.3 tons, and an ultimate stress of 31.7 tons and 21.7 per cent elongation on 2 inches in the form of sand castings; another of the present series, containing approximately 9 per cent of aluminum and 2 per cent of manganese, gave almost the same yield-point and ultimate stress as the 10 per cent copper-aluminum alloy, but showed 46 per cent elongation on 2 inches as compared with 36 per cent. In the form of rolled bars 13-16 inch in diameter, the best of the ternary alloys attained an ultimate stress of nearly 43 tons per square inch, with a yield-point of 23 tons and an extension of 22.5 per cent, while another alloy, with a yield-point of 19 tons and an ultimate strength of 40.5 tons, showed an elongation of 40 per cent on 2 inches. The results of these more detailed tensile tests led to the conclusion that the effect of the addition of manganese in relatively small quantities to alloys of copper and aluminum was to stiffen the alloy, that is, to raise its yield-point and its ultimate strength without reducing its ductility to a corresponding extent. The similarity of properties between small chill castings and hot-rolled bars, found by Messrs. Carpenter and Edwards, in the case of the 10 per cent copper-aluminum alloy, was not, however, reproduced in the present series of ternary alloys. Hardness tests, by both the Brinell ball method and by the Shore "scleroscope," were made on the nine selected alloys, and their hardness numbers were found to differ slightly (Brinell number varied from 170 to 199), a surprising result in view of the comparatively wide variations of tensile strength which exist between the different alloys.

Torsion Tests.

The torsion tests of these nine alloys yielded results generally consistent with those of the tensile tests, but one alloy, containing approximately 8 per cent of aluminum and 5 per cent manganese, gave both the highest maximum strength (in torsion) and the largest angle of twist—a remarkable result since in most groups of alloys the angle of twist diminishes rapidly as the maximum strength increases. The ratio of maximum stresses as found by torsion to those found by tension tests varied somewhat, from 0.75 to 0.90, but never reached or exceeded unity, as was the case with a number of the binary alloys of copper and aluminum.

The nine selected alloys were tested in the "alternating stress" machine at Sheffield University. The results showed variations, which could not, however, be ascribed to lack of uniformity in the material, but the mean results indicated that while none of the present series of ternary alloys were as good under this test as the ninth alloy of the Eighth Report, in view of the higher tensile strengths of the present alloys, their behavior under the Sheffield test was remarkably good. Three of the alloys containing 10 per cent aluminum and 1 per cent manganese, 10 per cent aluminum and 2 per cent manganese, and 9 per cent aluminum and 3 per cent manganese, respectively, were chosen for further

investigation. The elastic limits, as observed by the Ewing extensometer, were found to be approximately 8, 9 and 12 tons per square inch for the three alloys in numerical order.

Tensile Tests at High Temperatures.

Tensile tests at high temperatures gave results similar to those obtained for the 10 per cent copper-aluminum alloy described in the Eighth Report. The tensile strength appeared to be well maintained up to about 300 degrees Cent., but then fell off rapidly. The hope that the addition of manganese would materially improve the alloys in this respect has not been entirely verified, but probably on prolonged exposure to moderately high temperatures the ternary alloys would behave better than the pure copper-aluminums.

Dynamic and Abrasion Tests.

The dynamic tests carried out by Dr. Stanton included alternating-stress tests by direct reversals of stress, single-blow impact tests on the Izod machine, and repeated bending-impact tests with two different values of blow. Under the alternating-stress tests the three alloys behaved in an almost identical manner and the tests indicated that the safe range of maximum stress was approximately 25 tons per square inch when the rate of reversal approached 1,000 per minute; when this range was compared with that found for the copper-aluminum alloys of the Eighth Report at a slower rate of alternation, a correction of 10 per cent had to be applied, with the result that a difference of about 1 ton per square inch remained in the calculated safe ranges, the difference being in favor of the pure copper-aluminum alloy (10 per cent). Under the single-blow impact test, on the other hand, the present alloys showed an absorption of from 9.5 to 10.5 foot-pounds for fracture, the figure for the 10 per cent copper-aluminum alloy being only 4.5. Evidently the influence of manganese made itself felt in the power of the alloys to resist a sudden shock. Under the repeated bending-impact test, with a tup weighing 6.15 pounds falling through a height of 2.01 inches, one alloy, referred to as No. 2, gave the best results, fracturing only after over 900 blows, while No. 6 alloy failed under 600, the alloys under this test giving the same result as that derived from the mean of Prof. Arnold's figures. With the lighter tup (4.71 pounds) and lesser fall (1.01 inch) which are ordinarily used in impact tests on steel, the order of the three alloys was changed; all three, however, required more than 10,000 blows, while the best result yet obtained with Swedish Bessemer steel in the same circumstances was a resistance to 6,000 blows.

Abrasion Tests.

Abrasion tests were made on rings of the three alloys, and the alloys were found to offer a good resistance to abrasion; while rings of rail steel lost 64.5 milligrammes, and a ring of tool steel lost 27 milligrammes, a ring of alloy only lost 10 milligrammes, and two other alloys lost 13 and 11.6 milligrammes respectively. If the behavior of the alloys in practice should bear out these results, a field of special usefulness should be open to them, particularly as the alloys machine quite readily. The effects of both annealing and quenching the alloys at temperatures just above two critical ranges which have been observed on their cooling-curves were studied. The result of either annealing or quenching from temperatures near 550 degrees Cent. (1,022 degrees Fahr.) was not marked, although annealing injured the alloys showing the greater loss while subsequent quenching only restored them partially to their original condition. The alloy which lost 10 milligrammes, however, differed from the two others and from many other copper alloys in that annealing at 550 degrees Cent. did not injure it, but rather improved it, so fas as sand cast specimens were concerned. Annealing any of these alloys at temperatures above 800 degrees Cent. (1,472 degrees Fahr.) was found to injure them very seriously, while quenching them from this higher temperature produced a relatively hard and brittle material which possessed high tensile strength but very little ductility. One alloy in the form of a rolled bar, quenched from 850 degrees Cent. (1,562 degrees Fahr.) attained a tensile strength of 52 tons per square inch with an elongation of 3.5 per cent. This material shared with the cold-drawn bar of the same alloy the highest tensile strength yet found in these alloys, but the drawn bar had the advantage of possessing a higher elongation (10 per cent). The "annealing temperatures" of cold-drawn bars were also determined in connection with the study of heat-treatment, and it was found that the hardness due to cold-working began to disappear after the alloys had been exposed to a temperature of 550 degrees Cent.

Fresh and sea water corrosion tests were made by exposing samples of the alloys (sand cast) to the action of fresh and sea water in tanks in the laboratory, the alloys being exposed both singly and in contact with mild steel plates. All the alloys exhibited a marked resistance to corrosion; in fresh water the ternary alloys appeared to be less liable to corrosion than the binary alloys of copper and aluminum; in sea water, on the other hand, one specimen lost as much by corrosion as naval brass, while another showed no corrosion. In addition to these laboratory tests, specimens of the alloys were undergoing exposure to the sea at Portsmouth dockyard.

Special experiments were made to ascertain whether alloys of the type of those investigated could be prepared from manganese derived from a commercial 80 per cent ferro-manganese; the results obtained showed that if a cupro-ferro-manganese was first prepared and the alloy made from this the results were satisfactory, but that it is not possible to use ferro-manganese directly for the preparation of the copper-rich-alloys.

The Constitution of the Alloys.

With regard to the constitution of the alloys, the work embodied in the present report was confined to an approximate study of the constitution of the ternary alloys containing less than 11 per cent of aluminum and less than 10 per cent of manganese. These were studied by the determination of cooling-curves of over 100 alloys, while differential cooling-curves and photo-micrographs of a large number have also been prepared. The results of the investigation, so far as the freezing-points of the alloys were concerned, were embodied in a model of the "liquidus" surface of the alloys over the region named, and the contour lines of this model were exhibited at the meeting. While a discussion of the lower arrest-points, indicating thermal changes taking place in the alloys after solidification, served to show that the data as yet available —although very numerous—were not adequate for the solution of the complex problems involved, a discussion of the correlation of the shape of the "liquidus" surface, the micro-structure and the mechanical properties of the alloys revealed a series of interesting relationships, which served to clear up general questions as to the nature of the alloys.

The conclusions arrived at were, briefly, that within the limits of the alloys studied, the constitution of the ternary alloys very closely resembled that of the binary alloys of copper and aluminum; manganese influenced the properties of the alloys in a man-

ner similar to that of aluminum, but at a different rate. As regards the effects of annealing and quenching, the ternary alloys showed a strong similarity to the binary alloys.

Alloys Rich in Aluminum.

A preliminary study of the aluminum-manganese series of binary alloys was briefly described by the authors, the principal results being that a binary eutectic was found to exist close to the aluminum end of the series, while the alloys on the manganese side of this eutectic contained increasing qualities of the compound Al_3Mn. The existence of this hard, brittle compound at once limited the possible extent to which manganese could be usefully added to alloys consisting principally of aluminum. The study of ternary alloys had therefore been confined to the range containing less than 4 per cent of either copper or manganese.

The mechanical properties of this range were studied by eight "exploratory" meltings of which tensile tests on sand and chill castings were carried out. The results of these tests indicated that two alloys, those containing 2 per cent of copper and 2 per cent of manganese, and 3 per cent of copper and 1 per cent of manganese respectively, were worthy of further study. Larger quantities of these alloys were accordingly studied, and the results showed them to be very sensitive to casting temperatures. These were tested subsequently by a special experiment, and it was found that while a chill casting poured at a mean temperature of 680 degrees Cent. (1,256 degrees Fahr.) gave a tensile strength of 11.6 tons per square inch with an elongation of 8 per cent on 2 inches, the same metal poured into a similar mold at a mean temperature of 750 degrees Cent. (1,382 degrees Fahr.) gave a tensile strength of less than 6 tons per square inch, and an elongation of only 2 per cent—both castings being apparently quite sound.

Tensile Tests.

The results of tensile tests of sand castings of the two selected light alloys compared favorably with those of pure copper-aluminum alloys, and this was still more notable in the case of the chill castings. The tensile tests of an alloy containing 3 per cent copper, 1 per cent manganese, which stood at an ultimate strength of 12 tons per square inch, with an elongation of 13.5 per cent on 2 inches, were among the most remarkable results of the present report, since they considerably exceeded the results of any of the binary alloys of aluminum with copper. The authors had hoped that this difference in favor of the ternary alloys would be maintained when the alloys had been rolled into bars 13-16 inch in diameter; but although the results of tensile tests on these bars were slightly superior to those found in the binary series, the difference was not nearly so important as in the case of the chill castings; in the form of rolled bars there did not appear to be any advantage in using the ternary alloys as compared with the alloys of aluminum with copper alone. It was further found that the two selected light alloys could not be drawn cold to any considerable extent without drawing hollow, and even the moderate amount of cold working attempted in the case of that alloy in the process of "drawing and annealing" was found to produce hollowness; another alloy, however, with 2 per cent of each added metal, stood the process of drawing with annealing in a satisfactory manner. The specific gravity of the alloys had been determined in all the available conditions; they ranged in the case of one alloy from 2.71 to 2.80, and in the case of another from 2.67 to 2.79. In all cases the rolled material was markedly denser than the chill cast.

Other Tests on Light Alloys.

The elastic limits were 7.15 tons for both alloys. The elastic limits, thus determined, agreed approximately with the values deduced from alternating stress tests. Autographic stress strain diagrams were also taken from the 8-inch specimens used for elastic determination, and gave results which agree to a reasonable extent with the values found by tests on 2-inch specimens. The alternating stress tests gave results which indicated that one alloy possessed a safe range for alternating stresses of 9.4 tons per square inch, while for another the range was 8.8 tons per square inch. Under the single blow impact tests the two alloys absorbed 4.1 and 5.5 foot-pounds at fracture. Under the repeated bending-impact test as applied to the heavy alloys or to steel specimens, these light alloys would have fractured after few blows; a lower height of drop was accordingly employed (0.71 inch instead of 1.01), and with a tup weighing 4.71 pounds the alloys fractured after 590 and 672 blows respectively.

The Structure of Light Alloys.

The alloys all showed two definite arrest-points, while the majority showed three, and two even showed four such points. In these alloys, three distinct phases are found; these are a solid solution which is pure or nearly pure aluminum, containing some copper, but practically no manganese in solid solution; the aluminum-copper compound $CuAl_2$ and the aluminum-manganese compound Al_3Mn; the pyrometric evidence appeared to indicate that the freezing points of the eutectics formed by each of these compounds in combination with aluminum were affected—in the ternary alloys—by the presence of the other compound in the mother-liquor, while a ternary eutectic of the three phases was probably found in most of these alloys, being, of course, the last body to solidify.

Experiments were made to determine whether the use of ferro-manganese was permissible in the production of these alloys. A heat of an alloy was made in which the copper and manganese were introduced in the form of copper-ferro-manganese previously prepared from ferro-manganese; the resulting alloy contained 0.1 per cent of iron, and gave results which were slightly inferior to those of the original alloy. An alloy of another type was prepared by the use of ferro-manganese direct, the resulting alloy containing 0.52 per cent of iron, and this alloy gave results appreciably better than those obtained from the original. It was therefore probable that the introduction of small proportions of iron may materially improve these light alloys. The suggestion having been made to the authors that alloys of aluminum and manganese might possess a considerable power of resisting the attack of mineral acids, a series of experiments were made in which small blocks of a series of binary alloys of aluminum and manganese were exposed to nitric and sulphuric acid of 10 per cent and 50 per cent strengths; the results showed, however, that none of these alloys were even equal to pure aluminum in their acid-resisting properties.

GRINDING MOLDING SAND.

By W. J. Keep

Question:—Are there any advantages to be derived from grinding molding sand for stove plate use, providing the sand has been dried and passed through a 30-mesh riddle, except to disintegrate such small portions as will not pass through the riddle to prevent loss?

Is sand which has been dried naturally, previous to riddling, of greater value than that which has been dried by artificial heat?

What proportion of gangway scrap-

ings should be mixed with new sand, provided the same has been put through a fine riddle?

Answer:—Molding sand should not be ground, but should be put through a mill, which is provided with blades or pins that move rapidly in opposite directions. The dry sand is projected against these pins, thereby breaking up the lumps, and in this way is mixed thoroughly. The clay binder will be uniformly mixed, and the riddle is used for removing all foreign matter. For drying large quantities of sand, it is usually piled on sheet iron shelves, under which steam pipes are passed. After being dried, the sand is prepared for use in mixing machines. Natural drying of the sand is hardly practical, but in results there is no difference as compared with artificial drying. Passing such sand directly through a riddle would screen out the lumps of clay, and if there were any variation in the quality in different parts of the sand pile, care should be taken to mix it thoroughly before riddling. This is accomplished by shoveling it onto and from the drying shelves, and this also has a tendency to break up the lumps. Small foundries in which the sand is dried in this way produce very fine castings, free from the pits caused by the small particles of clay. It is not practical to run damp sand through a riddle fine enough to break up small particles of clay.

The molder, when taking the castings out of the sand, raps them very lightly, and the burnt sand that falls off is all that should be added to the heap. Gangway sand that is yellow may be thrown back onto the floor. The grains of good molding sand have sharp angles. Grinding between any kind of surfaces would break off these sharp angles, and would have a tendency to reduce the strength of the sand.

A SUCCESSFUL FOUNDRY COST SYSTEM*

BY J. P. GOLDEN

MY OBJECT in devising the following system, was to enable me to have a ready means of reference and comparison in the several foundry departments at all times, and incidentally to lower the cost per 100 pounds of castings, without extra clerical force or cost, or causing undue work for the foundry foreman, assistant, or cleaning room foreman. This system is not perfect and could be improved. To do so in our case, would require an increased clerical force, which would increase the non-producer cost per 100 pounds of output. For instance, in case a puiley with a cracked arm were to be remelted and without inquiry, I wished to know why it was to be made over, and by whom returned. The system referred to covers this case, also by whom the pulley was made, the time taken in making, weight of pulley, to whom sold, cause of crack, etc. These records are all accessible to both superintendent and foundry foreman under this system.

Should a molder ask increased wages, the system shows either the superintendent or foreman what class of work the man has been working on, his record, his present pay, whether by hour or piece, and the number of pieces lost, as well as the weight molded, also the means of comparing the wages and output of one man with another.

I also wished to have a method whereby the foundry foreman could see exactly what each department was doing, to allow him to correct any bad practice that he might control, so far as it rested with him.

I wished also to know at a glance what the cost per hundred pounds for clean castings was for last week, or last year, or the average for a year, how many pounds net, of clean castings were made in any week, or the average for a year, with the per cent loss for bad castings, as to wage cost alone for 100 pounds for any week, or yearly average, what the cost per hundred pounds was for either the non-producers, rumbling department, molding department, core shop, day or night cleaning gangs, etc.

I also wished to separate the different kinds of castings into classes, with current prices for these castings, for both our shop and customer, so that having the approximate cash value of castings, and deducting therefrom the cost of pig, scrap and coke, wages, and fixed expense per 100 pounds of castings, I would be able to find the approximate profit per week.

After a satisfactory trial of the following system for nearly two years, without extra clerical force or cost, (the weekly report being made up in the unoccupied time of a draftsman), it has occurred to me that there might be other members of the association to whom my system might be of interest.

Daily Cupola Report.

The system consists of a Daily Cupola Report, the printed form having columns for charge, number of pounds of coke and brand, pounds of pig iron and brand, and per cent silicon and sulphur; scrap, foreign and return, and total charge, also lines for weekly totals for use in weekly report; ratio of coke to iron, time started blast, time dropped bottom, average blast pressure, per cent sulphur in heat, per cent silicon in heat, and remarks. Each sheet is signed by the foreman.

Daily Foundry Report.

The Daily Foundry Report, Fig. 1, which is made up by the rumbling room foreman. This report consists of a sheet with columns for the name of the molder, hour or piece rate, number of molds, number of castings, time of helper, pattern description, with columns for weights of the various classes of work, as pulleys, sheaves, hangers, hanger boxes, pillow blocks, couplings, cane mills, factories, miscellaneous, etc., also a column for number of pieces lost, total weight of each kind of piece lost, and a cause column for same, showing if it did not run, if it was crushed, or whatever the cause or the defect. There is a line at the bottom of the sheet for weekly totals, to be used in the weekly report. The daily foundry report furnishes a ready means of comparison of each molder's record with his own, or with other molders, as to quantity of good castings, castings lost, weight and cost of the same. This report also shows the amount of good and bad castings for each day, in each class, with the weekly total for each.

Defective Castings.

There is a book for defective and other castings returned from shop

*Presented at the Cincinnati Convention of the American Foundrymen's Association.

and customers, in which is the following rule:

"All castings returned by machine shop and customers, before being made over, must be entered in this book, giving cause for making over. Castings returned to foundry from shop or customers, through no fault of foundry, must not be deducted from net foundry castings and should be considered as foreign scrap. If fault of foundry, they are charged back to foundry and are considered as foundry return scrap."

This book has columns, Fig. 2, for showing date returned, by whom, description, cause and weight. Without this book, there could be returned defective castings, which were the foundry's fault and made over without the superintendent's knowledge. With the "to be made over" casting book, all castings returned are specified therein. If the fault of the machine shop, it is so stated. If returned from customers, this is noted, with date, description, cause and weight. No casting is made over without being recorded in this book. This book being always open to the superintendent and foreman, saves inquiries and explanations. Possibly a few examples here will make the value of this book plainer. For example: The superintendent upon examination of this book, finds a record of a split pulley 36 x 12 inches, 2¼-inch bore, lug broken off in machine shop in splitting, or a record of a pulley 24 x 8 inches, 2-inch bore, bored too large in machine shop. These defective castings would not be due to any fault of the foundry, and the weights would not be deducted therefrom. The castings would be considered as foreign scrap. If the record showed a pulley 12 x 4 inches, 1 7/16-inch bore, with dirty face, or 12 gears returned by a customer, from no fault, except in excess of the order, or 25 J. I. castings returned by customer with too large cores, these would be the fault of the foundry, and the weights would be deducted from clean, net castings for the week in which they were recorded, and considered as return foundry scrap.

The Weekly Foundry Report Sheet, Fig. 3, is made up from the daily foundry report, and cupola sheets and the defective castings book. On this sheet, provision is made for a record of bad castings returned from the foundry, shop or customer, by classes, as well as the good castings made. The total of good castings, minus defective castings, gives net good castings for the week. The average per cent of all castings lost is given, with the per cent loss in each class, and with the total pounds of pig and foreign scrap charged in the cupola, and the net good castings deducted therefrom, we find the per cent lost in remelt, cupola droppings, gang-ways, etc. This loss is apt to deceive one, for where the foundryman would estimate a loss of 3 to 5 per cent on a certain class of work, he might overlook the fact that he had not taken into consideration the remelting loss of gates. For instance, upon exceedingly light work with 25 to 40 per cent gates, the loss from continued remelting, etc., might run as high as 8 or 10 per cent. The weekly foundry report also has a record of the total melt taken from the daily cupola sheet, which, with net good castings deducted, gives per cent of bad castings, gates, etc., of total melt, including foreign scrap, returns, and pig. In a division headed "cupola charge," is given the number of pounds of pig iron, foreign scrap and coke, with current price of each and total cost per week. To these amounts are added the total wages, giving a total of material and wages for the week, which, divided by the net good castings, gives the cost per 100 pounds net castings, including pig iron, scrap, coke and wages.

Non-Producers.

The weekly report also has separate divisions for non-producers, rumbling department, molding department, core shop, day and night cleaning gangs, in which the wages of each class of men in each division are given separately, by totals, and the wage cost per hundred pounds. For instance, in our own shop, the non-producer division includes the foundry foreman, assistant foreman, pulley man, craneman, the clerk (who is also rumbling room foreman), cupola tender, cupola helpers and carpenter, the separate wages per week of each being given, the total of all, and the wages cost per 100 pounds of net castings. The weekly report also embodies the grand total wage cost per 100 pounds and this is the most important item, for both foreman and superintendent, for this item is one which the foreman can control to the greatest extent, and which speaks the loudest in favor of the system.

DAILY FOUNDRY REPORT

GOLDENS' FOUNDRY AND MACHINE CO., COLUMBUS, GA. Date_____

Name	Hour or Piece Rate	Number of Molds	Number of Castings	Help	Pattern Description	Pulleys	Sheaves	Hangers	Hanger Boxes	Pillow Blocks	Couplings	Cane Mills	Lummus	Factory	Agricultural	Miscellaneous	Number Pieces Lost	Weight	Cause

The Foundry

FIG. 1—DAILY FOUNDRY REPORT SHEET

Date Returned	By Whom Returned	Description	Cause	Whose fault	Weight
Apr. 26, '09	Our Mch. shop	1 S. B. Pulley 36 x 8—2 3/16 in. bore.	Bored too large.	Mch. shop	240 pounds
Apr. 29, '09	Our Mch. shop	1 Split pulley 24 x 6—2 3/16 in. bore.	Broke lug splitting	Mch. shop	120 pounds
May 3, '09	Customer	12 Gear Castings P. 2.	Cored too large.	Foundry	14 pounds
May 5, '09	Foundry	1 D. B. Pulley 36 x 8—1 15/16 in. bore.	Blow-hole in face.	Foundry	260 pounds

FIG. 2—DEFECTIVE CASTINGS RECORD

Since the adoption of this system nearly two years ago, each period of six months' average records has shown a decided decrease in the wages cost per 100 pounds, amounting to nearly 20 per cent, since adopting the system.

In connection with the weekly report is a detailed report of the pounds of good castings, to whom sold or charged, and price for each lot, and from this sheet is prepared on the back of the weekly report, a

statement giving the estimated profit or loss for the week.

Comparison of Reports.

And lastly, there is a ready reference sheet, Fig. 4, headed "Comparison of per cents, wages cost per 100 pounds in different departments of the foundry from weekly foundry reports," giving the comparison by weeks and the average comparison at the end of each year of the following items: Net good castings for the week, castings killed in machine shop, etc. There are also columns for the cost per week per 100 pounds net castings, including pig iron, scrap, coke, and wages, the wage cost per 100 pounds in the non-producer, rumbling and molding departments, also the core shop, day and night cleaning gangs, with a column for grand total wage cost per 100 pounds.

Both the superintendent and foreman have access to the several reports, giving each the means of knowing the actual conditions in all departments of the foundry at all times. This system gives the foreman the means of remedying a small or defective output by the knowledge of the cause producing it, and to place each molder upon the class of work to which he is best fitted to increase the general output.

Incentive to Foreman.

It is an encouragement for a good foreman to know that every gain in his record is brought to the attention of the superintendent, and should he be a little careless at times, he knows that the report will show it, and he is more apt to avoid a bad report. Moreover, it sets a pace for him to keep up to, so if the production is a little light the first part of the week, he can often turn out a little more the last part to keep up the production.

Also, in the case of a change in foreman, not only does the superintendent have his judgment to base the worth of the new man upon, but the records themselves show the standing of the new man in comparison with the old, in the average wage cost per hundred pounds of net, clean castings under similar conditions.

The system also furnishes a basis for closer estimates than formerly, upon work a little out of the usual run, by knowing exactly what prices can be accepted for the regular work. The foundry foreman in this case is allowed nominal control of the foundry, hiring and discharging his men, fixing their wages, and increases in pay for his men are by his recommendations, subject to approval of the superintendent.

WEEKLY FOUNDRY REPORT.

GOLDENS' FOUNDRY AND MACHINE CO.

COLUMBUS, GA.

FOR WEEKS ENDING FRIDAY 19

	Pulleys	Sheaves	Hangers	Hanger Boxes	Pillow Blocks	Couplings	Cane Mills	Lummus	Factory	Agricultural	Miscellaneous	Total Weight
Bad castings returned from foundry												
Total pounds good castings made												
Defective castings returned from shop and customers												
Net good castings for week												
Total amount ( )												
Average per cent. of castings lost												

Total pounds pig and foreign scrap charged in cupola

Net good castings for week

Remainder

Per cent. lost in remelt, cupola droppings, gangways, etc.

Total melt

Net good castings

Per cent. bad castings, gates, etc. of total melt

Including foreign scrap, returns and pig

CUPOLA CHARGE

Pounds pig iron @ per hundred $

Pounds foreign scrap @ per hundred

Pounds coke @ per hundred

Total Wages $

Cost per hundred pounds net castings including pig iron, scrap, coke, wages. $

Total $

Material cost per hundred pounds net castings made as per sheet $

Total cost per hundred pounds net castings made as per sheet $

PROPORTIONATE WAGE COST PER HUNDRED POUNDS IN DIFFERENT DEPARTMENTS

NO.	NON-PRODUCERS	WAGES
	Foundry Foreman	$
	Foundry Assistant	
	Pulley man	
	Crane man	
	Clerk	
	Cupola tender	
	Cupola helpers	
	Carpenters	
	Watchman	
	Total $	

Wages cost per hundred pounds net castings, $

NO.	RUMBLING DEPARTMENT	WAGES
	Foreman	$
	Assistant	
	Men	
	Total $	

Wages cost per hundred pounds net castings, $ chipped, cleaned, and ready to ship.

NO.	MOLDING DEPARTMENT	WAGES
	Molders (White)	$
	Helpers (White)	
	Helpers (Black)	
	Total $	

Wages cost per hundred pounds net castings. $

NO.	CORE SHOP	WAGES
	Foreman	$
	Coremakers	
	Help	
	Total $	

Wages cost per hundred pounds net castings. $

NO.	NIGHT CLEANING GANG	WAGES
	Headmen	$
	Men	
	Total $	

Wages cost per hundred pounds net castings. $

NO.	DAY CLEANING GANG	WAGES
	Headmen	$
	Men	
	Total $	

Wages cost per hundred pounds net castings. $

GRAND TOTAL WAGE COST PER HUNDRED POUNDS $

The Foundry

Note.—Castings returned to foundry from our shop and customers, through no fault of the foundry, must not be deducted from net foundry castings, and should be put in foreign scrap pile. The weekly foundry report is made up from daily foundry report and cupola sheet.

FIG. 3—WEEKLY FOUNDRY REPORT SHEET

ANTI-ACID BRONZE.

Question:—Kindly give us a good mixture for an anti-acid bronze. It is to be used in tin plate mills for cradles used for dipping tin.

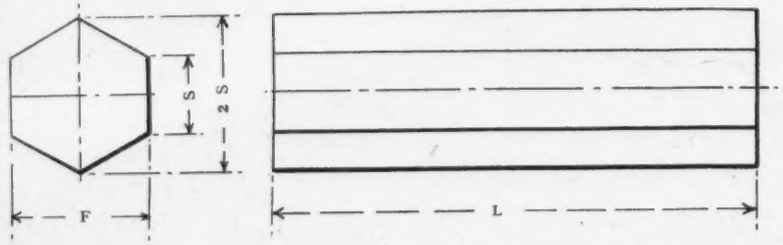
Answer:—There is no strictly anti-acid bronze, but the following alloy can be recommended: Copper 82 per cent, tin 6 per cent, and lead, 12 per cent.

FORMULAS FOR FINDING THE WEIGHT OF IRON CASTINGS.

By W. L. Tryon.

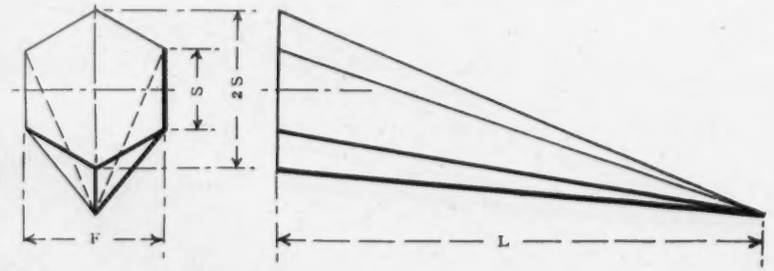
To find the weight of a hexagonal casting, multiply the square of the side by the length, by 0.677, or multiply the square of the distance across the flats by 0.226.

$$W = S^2 \times L \times 0.677 \text{ or } W = F^2 \times L \times 0.226.$$



To find the weight of a pyramid with a hexagonal base, multiply the square of the side by the length, by 0.226, or multiply the square of the distance across flats by the length, by 0.075.

$$W = S^2 \times L \times 0.226 \text{ or } W = F^2 \times L \times 0.075.$$



S = Length of side in inches.
L = Length of casting in inches.
F = Distance across flats in inches.
W = Weight of casting in pounds.

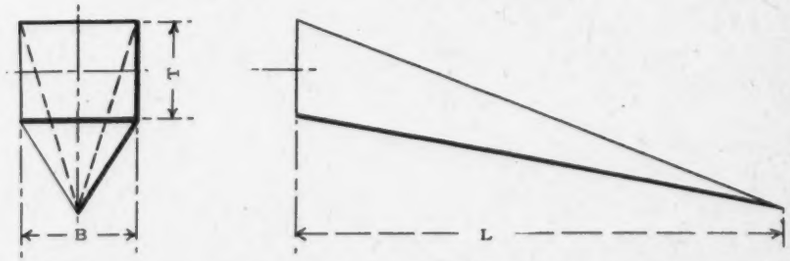
Data Sheet No. 61, The Foundry, March, 1910.

FORMULAS FOR FINDING THE WEIGHT OF IRON CASTINGS.

By W. L. Tryon.

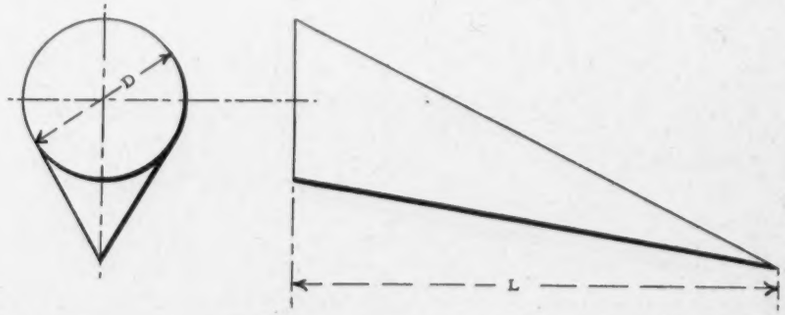
To find the weight of a pyramid with a rectangular base, multiply the thickness of the base by the breadth, by the length, by 0.0868.

$$W = T \times B \times L \times 0.0868.$$



To find the weight of a cone, multiply the diameter squared by the height by 0.0682.

$$W = D^2 \times L \times 0.0682.$$



T = Thickness of base in inches.
B = Breadth of base in inches.
L = Length in inches.
D = Diameter of base in inches.
W = Weight of casting in pounds.

Data Sheet No. 62, The Foundry, March, 1910.

Note--This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

THE FOUNDRY DATA SHEET, MARCH, 1910.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

METHODS OF MAKING CYLINDERS.

By W. L. Russell

This special class of high grade castings has at all times, in the history of the foundry trade, been given a front rank, and to be successful in this line speaks for itself. The methods of molding are numerous, owing to the many different types of steam cylinders. One method, which is followed by many foundrymen engaged in the making of cylinders, is to make the mold in green sand and to bake it in an oven. The manner in which they are molded is not of as great importance as the manner of gating and the mixtures used in their manufacture. The proper method of casting cylinders or any class of work, which has to withstand pressures, is on end, but when conditions are such that they must be poured flat, a very successful way is to run them in on the side port core, and with the use of a file flatten the top of the body core. In so doing, any dirt that may float will invariably concentrate around this portion of the casting and can readily be bored out. Chaplets should be used sparingly in the bore of a cylinder as they are detrimental to a perfect surface. I have seen cylinders, which were perfect in every detail, thrown out on account of imperfections in the bore. If, however, it is necessary to use chaplets, they should be perforated as they will melt with the metal and will cause no further trouble.

When pouring cylinders on end, there are several ways of gating, but the proper way is to gate them both top and bottom, which has been proven satisfactory by results. When gated wholly from the bottom, the iron grows sluggish as it rises to the top and will always be found to be dirty when bored out. When gating from top and bottom, the bottom gate is merely used for the purpose of covering the bottom of the mold. A stopper is used to cover the top gates until the bottom has been covered and then the stopper is removed and the iron drops into the mold. This will insure hot iron until the mold is filled and will also avoid trouble from dull and dirty iron in the upper portions of the casting. My personal experience is that a cylinder poured after this manner will invariably bore out cleaner than one poured from the bottom alone. The effect from the top gates is such that any small pieces dislodged from the mold or cores will be cut into small particles and will float to the surface where they can be machined off. Another important feature in gating is that gates should always be placed as far away as possible from finished parts, as dirt will always be found at or in close proximity to the pouring gates.

COMPARISON OF PER CENTS, WAGES COST PER HUNDRED POUNDS, &c., IN DIFFERENT DEPARTMENTS OF FOUNDRY, FROM WEEKLY FOUNDRY REPORTS.

19— GOLDENS' FOUNDRY & MACHINE CO. Week Ending	Net good castings for week	Castings killed in machine shop	Total average per cent. castings lost	Per cent. pulley castings lost	Per cent. sheave castings lost	Per cent. hanger castings lost	Per cent. hanger box castings lost	Per cent. P. block cast'gs lost	Per cent. coupling castings lost	Per cent. cube mill castings lost	Per cent. lumma castings lost	Per cent. factory castings lost	Per cent. agricultural castings lost	Per cent. miscellaneous cast'gs lost	Per cent. lost in result, cu pola drop pings, gang way, &c.	Per cent. bad castings, gates, &c., of total melt, including P. & return &c.	Cost per 100 pounds net casting, including pig iron, scrap, coke and wages	Non-producers wages cost per 100 pounds net castings	Rumbling department wage cost per 100 pounds net castings, chipped, cleaned and ready to ship	Molding department wages cost per 100 pounds net castings	Core shop wages cost per 100 pounds net castings	Night Cleaning Gang wages cost per 100 pounds net castings	Day Cleaning Gang wages cost per 100 pounds net castings	Grand total wages cost per 100 pounds

The Foundry

Fig. 4—Weekly Summary Giving Percentage Comparisons of Wage Cost per 100 Pounds of Castings in Different Departments of the Foundry

With the jacketed steam cylinder we have another problem which has caused many a foundryman anxiety. The great trouble arises in the uniformity of thicknesses, which vary from 2½ inches in the bore to ⅞ inch and even ⅝ inch outside wall, while the ribs or partitions connecting the wall will be from 1 inch to 1½ inches. We have three and frequently more thicknesses to contend with. The foundryman must exercise his ingenuity to get a perfect casting under these conditions, as it will be plainly seen that the thin walls will solidify first and naturally will be close-grained, while the heavy body will be open-grained.

The following are two mixtures which have given excellent results in the above class of work:

For light castings: Silicon, 2.40 to 2.50 per cent; sulphur, 0.08 to 0.09 per cent; phosphorus, 0.70 to 0.90 per cent, and manganese, 0.50 to 0.55 per cent.

For heavy castings: Silicon, 1.25 to 2.00 per cent; sulphur, 0.09 to 0.11 per cent; phosphorus, 0.40 to 0.65 per cent; manganese, 0.60 to 0.80 per cent.

The mixture for heavy cylinders is one of the best, the high sulphur causing a very fine wearing surface, which is one of the important factors in the manufacture of this special grade of work.

BEST IRON FOR GRATE BARS.

By W. J. Keep

Question:—We have recently started a foundry and we have learned that considerable difficulty has been experienced in this section in obtaining grate bars that will give satisfactory service. What mixture should we have to produce serviceable grate bars? We have No. 1 foundry pig iron, machinery and stove scrap.

Answer:—I presume that a grate bar quite high in silicon, approximately 2.75 per cent, and low in sulphur and phosphorus, will give you the best results. Grate bars are usually made from scrap iron. I know of no experiments that have been conducted to determine the best analysis for grate bars, and I am of the opinion that such a test would be very expensive to conduct.

FOUNDRYMEN'S CONVENTION AT DETROIT

Exhibit of foundry equipment and supplies promises to surpass previous displays---Silver cups and the gold medal

THE present indications point to a record-breaking exhibit of foundry and pattern shop supplies and equipment at Detroit during Founders' Week, June 6 to 11. Applications for space already exceed the total sold at the Cincinnati convention, and the outlook is favorable for the sale of about twice as much space as at any previous exhibit.

The City of the Straits, which has always been an important foundry center, has made rapid strides in recent years as a result of the concentration of the automobile industry in southeastern Michigan, and at the present time no less than 10 new foundries are being built in Detroit and immediate vicinity, to supply the requirements of the motor car industry. The brass foundry trade, especially, has forged rapidly to the front, and Detroit now takes rank with the leading non-ferrous casting centers of the United States. For many years this city has been the most important stove manufacturing center in the middle west, and many gray iron foundries in this district, during the past few years, have undertaken to specialize in intricate automobile work.

The local interest, of itself, in the exhibit of foundry equipment will be tremendous, and the increased space asked for by the manufacturers is indicative of a thorough appreciation of Detroit as a foundry center. The attendance will undoubtedly be heavy, as foundrymen from all parts of the United States will be attracted to the City of the Straits, not only by the conventions of the various technical societies and the exhibit, but by the opportunity afforded to inspect some of the most modern casting plants of the world.

Makers of platers' supplies and equipment, polishing and buffing machinery, are seeking membership in the Foundry and Manufacturers' Supply Association, and the space that will be allotted these concerns already promises to be extensive.

The announcement of the award of two silver loving cups by THE FOUNDRY has aroused great interest among the prospective exhibitors, and the competition for these trophies promises to be keen. The following communications regarding these awards have been received from officers of the Foundry and Manufacturers' Supply Association:

From F. N. Perkins.

Referring to your offer of two silver loving cups for the best still and running exhibits at the coming Detroit convention of the Foundry and Manufacturers' Supply Association, I can assure you it has my hearty approval, and the offer will be given due consideration at the next meeting of the trustees, who no doubt will authorize the appointment of an unbiased committee to make the awards.

The awarding committee, in my judgment, should not be members of our Association. This offer will cause rivalry between members of our Association, which will tend to make their exhibits more attractive each year, and is in keeping with the enterprise of THE FOUNDRY, and should be highly appreciated by members as well as the visitors.

F. N. Perkins, president, Foundry and Manufacturers' Supply Association.

From C. E. Hoyt.

I note the announcement in the February issue of THE FOUNDRY to the effect that THE FOUNDRY will offer two handsome silver loving cups, one to the best operating exhibit, and one to the best still exhibit, at the Detroit convention. This is splendid, and will do much to create interest among the exhibitors, and will bring the coming event to the attention of foundrymen and manufacturers all over the country. I appreciate the assistance this will be to me in my efforts to make the Detroit exhibit a great success.

C. E. Hoyt, secretary, the Foundry and Manufacturers' Supply Association.

From J. S. McCormick.

We note the announcement in the February issue of THE FOUNDRY that you will present two handsome silver loving cups for the best exhibits that will be made in Detroit. We believe this will cause considerable rivalry between the foundry supply men, and certainly ought to prove beneficial to the foundrymen and also the supply manufacturers. We are very glad to know that THE FOUNDRY has taken up this matter.

J. S. McCormick, treasurer, the Foundry and Manufacturers' Supply Association.

From Frederic B. Stevens.

I have received your printed announcement of the prizes which you are to offer, consisting of two handsome silver loving cups for the best exhibits at the foundrymen's convention in Detroit. I do not believe that I can make any comment concerning your generous action beyond commendation to you for this most excellent method of stimulating the interest, and the effort on the part of the exhibitors to excel, in every possible way, their competitors in making an attractive, and if possible, instructive exhibit. Such effort would contribute to the double purpose of making the exhibit part of the convention most attractive, and furthermore to giving them better results. Altogether, your idea is most worthy of encouragement.

Frederic B. Stevens, vice president, the Foundry and Manufacturers' Supply Association.

Gold Medal.

Great interest has also been manifested in the announcement of the annual award of a gold medal for the greatest achievement in foundry practice, the bestowal of which will be one of the features of the future meetings of the American Foundrymen's Association. The following appreciative communications have been received:

From Arthur T. Waterfall.

I wish to acknowledge receipt of the announcement of the proposed award of a gold medal for the most notable achievement in foundry work, and of your notice that the conferring of this honor will be left to the American Foundrymen's Association. I am sure that the proper qualifications of a committee for the purpose could not be better secured than through the personnel of the past presidents of the Association with the eminent, practical and oldest executive of the Association—J. S. Seaman, of Pittsburg—as chairman. The prospective award of this medal will surely have a tendency to stimulate further interest among those engaged in the attempt to improve existing foundry methods.

Arthur T. Waterfall, president, American Foundrymen's Association.

From W. R. Webster.

I have your announcement of your intention to award a gold medal annually for the most notable achievement in foundry work. It is apparent that this will have a very beneficial effect upon the industry by stimulating study and investigation on the part of foundry foremen and others similarly situated.

W. R. Webster, president American Brass Founders' Association.

From Thomas D. West.

It will afford me pleasure to serve on the committee of which Mr. Sea-

man is chairman. The object is a worthy one and should be productive of much good.

Thomas D. West, ex-president, American Foundrymen's Association.

From E. E. Brown.

I note your announcement regarding a gold medal award, and it appears to me that a prize of this nature would be of the highest value. It would create an interest in the advancement of foundry work that could not be attained any other way, and I most heartily indorse your offer.

E. E. Brown, E. E. Brown & Co., Philadelphia.

From L. W. Olson.

I have your announcement of your plan to award a gold medal for the most notable achievement in foundry work, and I believe this should have the effect of promulgating research work and investigations of various kinds along the lines of foundry practice. While this is very commendable, it would have been fine had it been possible for the Foundrymen's Association to have given this medal. However, I do not bring this forward as detracting at all from the sincerity of your intentions.

L. W. Olson, vice president, American Brass Founders' Association.

From W. M. Corse.

I was pleased to read over the announcement that your paper has made regarding the award of a gold medal for the best achievement in foundry practice for the coming year, and also the cups for the best exhibits. I feel quite sure that this will stimulate interest in foundry subjects, and is one of the best ways, I think, of accomplishing this end.

W. M. Corse, secretary, American Brass Founders' Association.

From C. H. Gale.

The annual award of a gold medal for the most notable achievement in foundry practice will be welcomed by foundrymen everywhere, and while there will be advances in foundry practice in the future as in the past, the annual award of the gold medal carrying with it the official recognition of the American Foundrymen's Association of an achievement worthy of note, will prove an additional incentive to earnest effort. The foundrymen are to be congratulated and you are to be complimented for this further demonstration of interest in the advancement of foundry practice.

C. H. Gale, superintendent, Pennsylvania Malleable Co., McKees Rocks, Pa.

From A. W. Walker.

There can certainly be no objection on the part of any ex-president of the American Foundrymen's Association serving upon such a committee as you suggest, except perhaps that it is not always possible to break away from home and attend the conventions. I should be very glad to be of any assistance in any way.

A. W. Walker, ex-president, American Foundrymen's Association.

CAST IRON FOR FIRE POTS AND BOILER SECTIONS.

By N. W. Shed

Question:—As we understand it, the hardness of cast iron, as well as the strength, is not directly due to the several amounts of the elements silicon, sulphur, phosphorus and manganese, but rather to the relation of the graphitic and combined carbons, as obtained by the manipulation of the first four named elements.

If this is true, in order to state this question more clearly, we will assume that the casting has the following analysis: Silicon, 2 per cent; sulphur, 0.08 per cent; phosphorus, 0.65 per cent; manganese, 0.45 per cent. This mixture gives us a certain hardness and strength. Is it right to assume that we can obtain the same hardness and strength by having in our castings a higher silicon, approximately 2.40 per cent, and having manganese 0.55 to 0.60 per cent? In other words, with sulphur and phosphorus constant can we take care of the rise in silicon by an increase in manganese and expect to hold the same results as regards hardness and strength, particularly the latter?

Is one of these mixtures any better than the other for withstanding continued heat from a coal fire and such exposure as that to which fire pot and flue sections of cast iron boilers are subjected. What is a good mixture for this class of work where the average thickness of section is ⅛ inch? The castings, of course, cannot possibly be porous.

Answer:—While it is true, generally speaking, that manganese has a hardening tendency, the small increase referred to, 0.15 per cent, has practically no effect on the hardness or strength. When the manganese is over 1.20 per cent, its effect as a hardener is noticeable, and at 2.50 per cent it is quite marked. At 8 and 10 per cent the manganese throws all the carbon into the combined form, and spiegel is produced, which is a white iron.

The casting with 2.40 per cent silicon and 0.60 per cent manganese would be softer than the casting containing 2 per cent silicon and 0.45 per cent manganese. To harden the iron, the silicon should be reduced. The 0.60 per cent of manganese is better than 0.45 per cent, as it counteracts the effect of sulphur, which is a much greater hardener than manganese. If a mixture carries a large per cent of manganese, approximately 1 per cent or over, a certain amount of the sulphur, and sometimes one half of this element is removed. Manganese is a powerful deoxidizer, and its great value consists in removing the oxygen from the oxide of iron, which is often produced in the cupola by excessive blast and insufficient coke.

A mixture containing 2.40 per cent silicon and 0.60 per cent manganese is better for withstanding the continued heat of a coal fire. As this iron is exposed to considerable expansion and contraction, a low phosphorus iron would be better for this purpose. An iron of the following composition would give excellent results under such conditions: Silicon, 2.50 per cent; sulphur, 0.07 per cent or less; phosphorus, 0.20 per cent or less; manganese, 0.80 per cent to 1 per cent. A Bessemer pig, high in silicon, would produce such a casting. Bessemer iron is, however, now made much lower in silicon than formerly, and it would be well to add 10 per cent of some high silicon pig iron to this mixture.

FLUX FOR BRAZING CAST IRON.

A new flux for brazing cast iron is being used successfully in France. It consists of the following: Zinc chloride, 38 parts; fused borax, 60 parts; potassium permanganate, 2 parts. The ingredients are ground together and are applied to the surface, slightly moist. The zinc chloride gives the necessary moisture to the mass, particularly if left exposed to the air. The theory of the mixture lies in the use of the potassium permanganate, which serves to oxidize the carbon on the surface of the cast iron. The borax and zinc chloride are claimed to act as agents for dissolving the oxide on the surface while the heating is taking place.

In accordance with the custom established three years ago, the American Blower Co., Detroit, has presented each of its employes with a sum in dollars equal to the years of his continued service with this concern. To commemorate the holiday season a booklet was also issued for distribution among the employes, which contains sketches and photographs of the officers and department heads of the American Blower Co., as well as a brief historical sketch of the organization and development of this company.

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Alloys Research

The Ninth Report of the Alloys Research Committee recently presented at a meeting of the Institution of Mechanical Engineers, is a further investigation into the properties of the alloys of copper and aluminum, special inquiry having been made to ascertain the effect of the addition of manganese to these alloys. Some estimation of the magnitude of the research may be formed when it is pointed out that in any complete study of a ternary system no less than 1,250 alloys have to be considered. The authors, Dr. W. Rosenhain and F. C. A. H. Lantsberry, confined their investigation to a range of alloys containing less than 10 per cent of manganese and less than 11 per cent of aluminum. As compared with the best of the binary alloys of copper and aluminum, the ternary alloys present certain advantages, consisting chiefly of a slightly higher ultimate stress and an undiminished ductility. One alloy containing about 10 per cent of aluminum and 1 per cent of manganese, in the form of sand castings, showed an ultimate strength of 72,000 pounds per square inch, with an elongation of 22.5 per cent in 2 inches. As regards light alloys, consisting principally of aluminum, the results are not so favorable as in the case of the heavy alloys. The most striking result obtained is that of the tensile tests of chilled castings of an alloy containing about 3 per cent of copper and 1 per cent of manganese, which showed a tensile strength of 24,000 pounds per square inch, and 13.5 per cent elongation in 2 inches. An interesting feature of the results obtained with these alloys is the determination of the great extent to which the properties of the metals depend, in the case of castings, on the temperature at which the metal is poured into the molds.

Trade Outlook

Pig iron values have a tendency toward a lower level and concessions made during the past 30 days indicate that stocks in blast furnace yards are of fair proportions. The large purchase of Bessemer iron by the United States Steel Corporation was made on a basis, practically $1.00 a ton below the prevailing market, and other grades of pig metal have declined in sympathy. Southern iron is again being sold on a basis of $13.00 for No. 2, Birmingham, and in the Chicago district, No. 2, local, is held on a basis of $19.00. Other quotations are as follows: No. 2, standard, Philadelphia, $18.75; No. 2, Southern, Cincinnati, $17.00; basic, delivered Eastern Pennsylvania, $18.50; basic, Pittsburg, $17.15; Bessemer, Pittsburg, $18.90; Lake Superior charcoal, Chicago, $19.50. Statistics compiled by the American Iron & Steel Association show that the total production of all kinds of pig iron in 1909 amounted to 25,795,471 gross tons, against 15,936,018 tons in 1908, an increase of 9,859,453 tons, or about 61.8 per cent. The 1909 production was the greatest in our history, and exceeded by 14,110 tons that of the banner year, 1907. Both lake and electrolytic copper remain practically unchanged in price, and are quoted on the basis of 13.75c for the former, and 13.50c for the latter. Pig tin is slightly higher and is held at about 33c, New York.

Pacific Coast Foundry Trade

The past thirty days has witnessed the growth of a better tone in the foundry trade of the Pacific coast. A larger volume of work is coming to the jobbing shops and the manufacturing plants are consistently busy. A number of sizeable contracts for building castings have been let recently at prices which indicate some improvement over the dead low level prevailing throughout last year. The local pig iron market continues to be attractive from the consumer's standpoint, although the general tone is very firm and prices will very probably increase materially as spring advances. No. 1 English foundry irons are quoted at $24.00, Seattle, for immediate delivery, grading down to $23.00 for late spring delivery. The improvement in the foundry trade is general throughout the entire Pacific coast territory, Los Angeles, San Francisco, Portland and Seattle reporting similar improved conditions. The high price of foundry scrap is stimulating the consumption of both steel scrap and low grade pig iron by Pacific coast foundries. The increase in the foundry consumption of steel scrap is estimated at 40 per cent in the past six months, while recent sales of round tonnages of Doncaster and Chinese pig indicate the renewed capacity of the market to absorb cheaper grades of pig iron.

PERSONAL.

C. J. Morgan, vice president of the Taylor & Boggis Foundry Co., Cleveland, sailed from San Francisco, Feb. 5, on the Cleveland, for a trip around the world.

William Holland has resigned as president and general manager of the Sibley Machine Tool Co., South Bend, Ind., and will organize a company and engage in the jobbing foundry business in that city.

C. B. Kerr, chief engineer of the Kerr Turbine Co., Wellsville, N. Y., has resigned and will hereafter devote his attention to the development of a centrifugal pump and other lines of mechanical devices under patents which he holds. J. L. Moore, chief designer of the Kerr Turbine Co., will succeed to the office of chief engineer.

Eduardo Espana Saucedo, connected with Ph. Bonvillain and E. Ronceray, Paris, France, molding machine manufacturers, who has been in this country for nearly a year and a half in the interests of this concern, sailed for Spain on Feb. 19, and will return to Paris about the middle of March.

Dr. Edward Goodrich Acheson, of Niagara Falls, N. Y., was presented with the Perkin medal at a meeting of the Chemists' Club, recently held in New York City.

A. Falkenau, formerly superintendent of the Falkenau-Sinclair Machine Co., Philadelphia, has become associated with George G. Hooper, industrial engineer, 165 Broadway, New York City. This concern makes a specialty of foundry engineering.

E. E. Miller has been elected vice president of the Falcon Bronze Co., Youngstown, O. Thomas Parrock has been made treasurer. The other officers of the company are G. A. Doeright, president and general manager; J. G. Haney, secretary, and R. H. Doeright, superintendent.

Melvin Henry recently resigned the superintendency of the foundry of the Buhl Malleable Co., Detroit, to accept the position of manager of the American Brake Shoe Co.'s malleable department, Lancaster, N. Y.

J. W. Henderson has resigned as treasurer of the Gulick-Henderson Co., Pittsburg, inspecting engineers, metallurgists and chemists, to accept the position of manager of the Verona Works of the Standard Steel Car Co., formerly known as the General Castings Co. The metallurgical and foundry department of the Gulick-Henderson Co., which was in charge of Mr. Henderson, will in the future be taken care of by W. G. Ireland, who is well equipped, by many years experience, to take up this work.

R. G. Harrison, 742 Bryn Mawr road, Pittsburg, who for several years has been city salesman for the J. S. McCormick Co., Pittsburg, has severed his connection with that concern.

James Savage has taken charge of the brass foundry of the F. I. A. T. Co., Poughkeepsie, N. Y.

A. J. Vaughn has resigned as superintendent of the Mitchell & Van Meter Co., Pottstown, Pa.

James Merritt has been appointed superintendent of the Federal Steel Foundry Co., Chester, Pa., thus returning to a position which he held some years ago.

Waddill Catchings, who was secretary for the receivers of Milliken Bros., New York City, has been appointed secretary to president August Heckscher, of the Central Foundry Co., New York City.

Walter Loring Webb has become associated with the engineering firm of the Roberts & Abbott Co., Inc., Cleveland, and will represent this concern in Philadelphia with offices in the Real Estate Trust Building.

Walter Laidlaw, originally identified with the Laidlaw-Dunn-Gordon Co., Cincinnati, and general manager of the Snow Steam Pump Works, Buffalo, will hereafter be located in the New York office of the International Steam Pump Co.

A. Burchard, of the firm of Burchard & Chase, consulting engineers, Cuyahoga building, Cleveland, has been appointed director of the mechanical section of the American Exposition, which will be held in Berlin, Germany, during June, July and August. An allotment of 15,000 square feet has been made for the exhibits of this section, and reservations can be made and full particulars regarding the exposition can be obtained from Mr. Burchard.

C. M. Trivett, formerly associated with Rogers, Brown & Co., is now connected with Nash, Isham & Co., New York City, and will look after the sale of pig iron and coke for this concern in Pennsylvania and southern territory, with headquarters in Philadelphia. R. H. Rehm will represent Nash, Isham & Co. in the New England territory.

OBITUARY.

Alex. Faulkner, ex-treasurer of the International Molders' Union, died at his home in Cleveland, Tuesday, Jan. 25. He was born Sept. 28, 1837, at Staleybridge, Lancaster, England, but when he was five years old his parents moved to Toronto, Canada. He served an apprenticeship with the firm of Hamilton & Sons of that city, and became a member of Local 28 of Toronto in 1860. In 1865 he was appointed superintendent of the plant of the American Fence Foundry Co., Cleveland. Mr. Faulkner was business agent and corresponding representative of Local No. 27 of Cleveland for over 15 years, and in 1902 was elected treasurer of the International Molders' Union at the Toronto convention. He was likewise a delegate to many of the national conventions held by this organization.

James C. Reymer, vice president of the Pittsburg Mfg. Co., died at his home in Pittsburg, Sunday, Feb. 6. Mr. Reymer at an early age became identified with the Fort Pitt Foundry & Machine Co., and later was connected with the Pittsburg Mfg. Co., of which he was vice president at the time of his death.

"DURATUM."

A new aluminum and magnesium alloy called "Duratum" has been patented by Jos. G. Mellen of the Auroid Metal Co., Bridgeport, Conn. It consists of aluminum, 79 per cent; magnesium, 11 per cent., and phosphor-copper, 10 per cent. The phosphor-copper used, contains 99.5 per cent copper and 0.5 per cent phosphorus. This alloy has about the same specific gravity as aluminum, but is much harder and machines well, and is used for making sand castings. The object of the phosphorus, the inventor states, is to prevent the oxidation of the magnesium in melting.

Announcement has been made of the consolidation of *Industrial Engineering*, heretofore published at Pittsburg, and *The Engineering Digest*, New York. The offices of the consolidated publications will be at 220 Broadway, New York City. Robert Thurston Kent, editor of *Industrial Engineering*, is managing editor, and Harwood Frost, who was the founder of the *Engineering Digest* and one of its editors, will now devote himself entirely to the *Engineering News*. The consolidated magazines will be conducted under the name of *Industrial Engineering*.

MODERN EQUIPMENT FOR THE FOUNDRY

Jar ramming molding machine with movable air cylinders --- Molding machines for deep work --- Steel pattern storage racks --- Welded chaplet --- Lined riser pots

A JAR ramming molding machine, which in design is a marked departure from other types of molding machines employing the jolt ramming principle, is shown in Figs. 1, 2 and 3. For lifting the platen or table, two small air cylinders are used in place of one large cylinder, and these contact with the table at the ends instead of at the center. By the use of two air cylinders distributed in this way, it is claimed that the air consumption is greatly reduced. From base to the top of the platen, the machine is only 18⅜ inches high, making it possible to operate the machine above the foundry floor level, and being portable, it can be used to advantage in the core room, as well as in the foundry. The base is 24 x 60 inches, and if desired, the machine can be lowered into a pit with the table on a level with the foundry floor. If placed in a pit, the adjustment of the stroke can be made above the foundry floor level.

The two air cylinders are bolted to a slot extending the length of the base, and can be moved back and forth to accommodate the varying sizes of tables used for different classes of work. In Fig. 1, these cylinders are bolted near the center of the base to accommodate the smallest table used, which is 24 x 32 inches. In Fig. 2, the air cylinders have been moved out near the ends of the base for a longer table to accommodate a larger size flask.

The valves are enclosed in the cylinders and are so designed that the formation of an air cushion is entirely eliminated. When operating the machine, air at 80 pounds pressure enters the main valve *1*, Fig. 3, and passed into hose *3* and *3-1*, connecting the cylinder valves with the main valves through port *A*. The air then passes into opening *9*—the cylinder valve being in its intake position—and spring *7* holds the cylinder valve until the exhaust valve *8* has been seated. The air then fills passage *B*, opens valve *6*, and fills cylinders *4*. This raises both pistons *5*, which are attached to table *20*, on which the flask with the pattern is located. At the same time, regulating block *10* is raised until the stroke adjusting block *G*, used to adjust the length of the stroke necessary to ram the various sizes of flasks, comes in contact with roller *7*. This moves the release lever *11*, forcing piston *2* downward, closing port *Y*, thereby cutting off the air from the main line, and permits spring *7* in the cylinder valve to close valve *6*. A further movement of piston *2* in valve *1* brings ports *X* and *Z* of piston *2* into communication with ports *C* and *X* of valve *1*, and exhausts the air from hose *3* and *3-1*, port *A*, opening *9* and the cylinder valves.

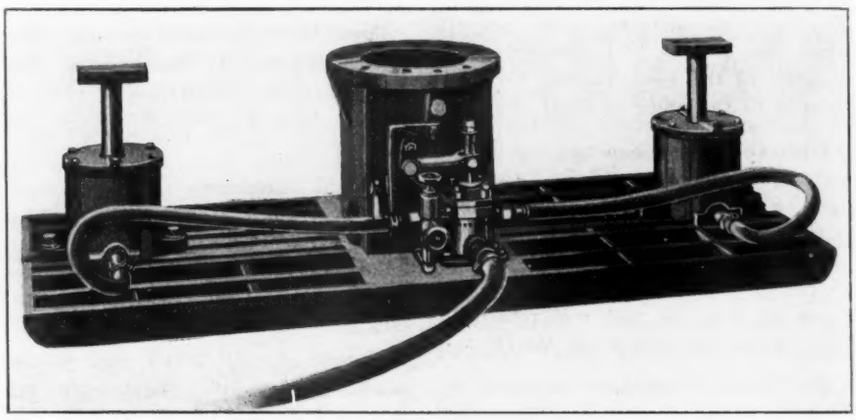

FIG. 2—JAR RAMMING MOLDING MACHINE WITH AIR CYLINDERS MOVED TO THE ENDS OF THE BASE FOR A LARGE TABLE

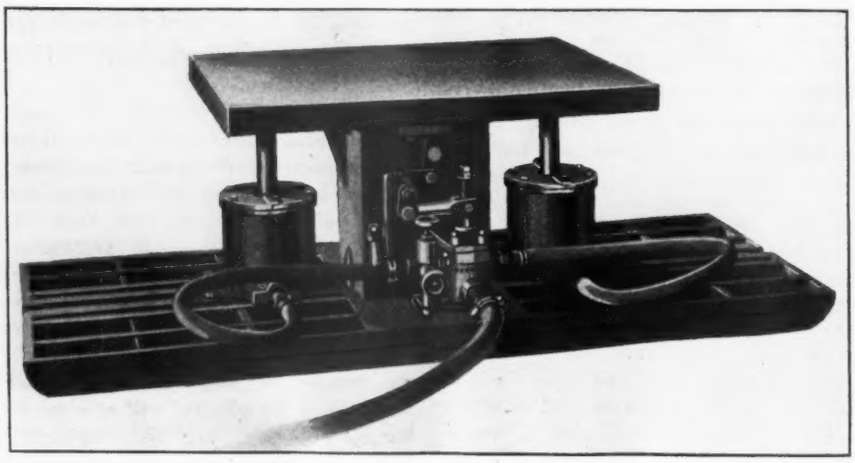

FIG. 1—JAR RAMMING MOLDING MACHINE WITH AIR CYLINDERS BOLTED NEAR THE CENTER OF THE BASE TO ACCOMMODATE A SMALL TABLE

The pressure in cylinders *4* causes the exhaust valve *8* to open, and the air passing through exhaust port *A* exhausts chamber *E*, the air passing out through port *F*. This results in the instantaneous release of the platen, which contacts with anvil *15*, and brings roller *7* in contact with stationary block *J*, thereby moving piston *2* in valve *1* upwards, bringing ports *Y* and *C* into communication to repeat the operation. Cast iron piston rings are used in the air cylinders.

The machine illustrated is the smallest size made and has a capacity of 3,000 pounds. However, jar ramming machines up to 10 tons capacity will be built embodying the same design. As the length of the table is not limited, the machine can be used to advantage

for molding lamp posts, columns and large sizes of cast iron pipe.

This jar ramming molding machine is built by the E. Killing's Molding Machine Works, Davenport, Ia., and has been in constant operation in the foundry, operated by this concern, for nearly a year.

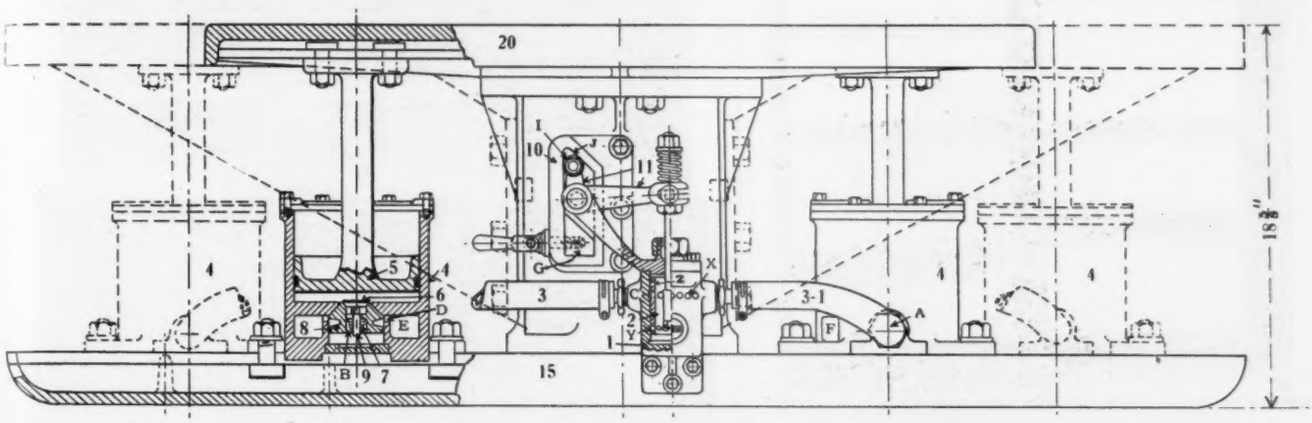

FIG. 3—JAR RAMMING MOLDING MACHINE, SHOWING VALVE MECHANISM

FLASK STRIPPING MOLDING MACHINE FOR DEEP DRAWS.

A flask stripping molding machine designed for deep draws, made by Osborn Mfg. Co., Cleveland, is illustrated in Figs. 1 and 2. This machine embodies all of the essential features of the flask stripping molding machine described in THE FOUNDRY, February, 1910, the folding link movement being employed to lower the pattern out of the mold. The machine is designed to be placed in a pit, the drawing table and flask supports being set at any desired height above the floor level.

In Fig. 1 is shown a transformer box pattern, mounted on the machine in ramming position. The pattern is supported on a plate attached to two pattern guides, and the pattern strips through the plate. However, the pattern and plate can be lowered together, if desired. To facilitate the raising and lowering of the pattern, it is counterbalanced by four weights, and when the pattern is being lowered, the chains from which the weights are suspended wind up on an eccentric. The weights in their elevated position, with the pattern lowered, are shown in Fig. 2. The machine is so constructed that when the pattern is in position for ramming the molds, the folding links pass slightly over center, making it impossible to lower the pattern while the mold is being made. The hand wheel for lowering and raising the pattern is above the floor level, but if desired the pattern can be actuated by a small motor in a pit. Adjustable guides are provided, of sufficient length to insure an absolutely even draw. The pattern on this machine has projecting lugs, which are drawn in before the pattern is stripped from the mold. This machine is especially adapted for deep work of floor size, and has been in successful operation for three years on molds for transformer boxes. When these molds were made on the floor, three were considered a day's work for one man, but with this machine, two men can make 18 molds per day. This machine is built in various sizes for flasks from 16 x 20 inches to 28 x 36 inches, and for drawing patterns 16 to 36 inches deep.

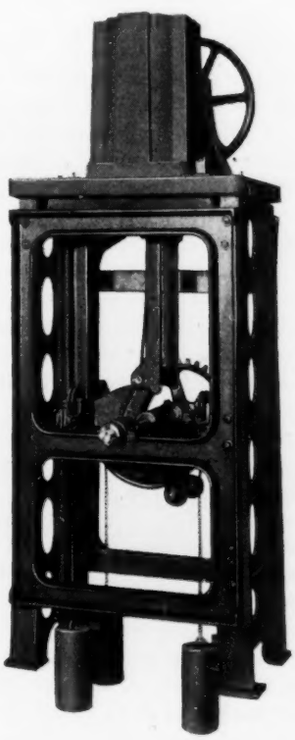

FIG. 1—MOLDING MACHINE FOR DEEP WORK WITH PATTERN IN MOLDING POSITION

HARD SOLDER FOR CAST IRON.

R. F. Lang, 31 Broadway, New York City, is offering to the foundry trade a new hard solder for cast iron known by the trade name of "Ferrool Hocksit." This solder is in the form of a paste ready for immediate use, which it is claimed, with a small quantity of brass solder, borax, and a charcoal fire, will restore any broken or fractured cast iron section to its original state. The fractured surfaces are so thoroughly soldered that the broken area cannot be detected. This solder can also be used for soldering cast iron to steel, copper, brass, etc. In using this material, the fractured sur-

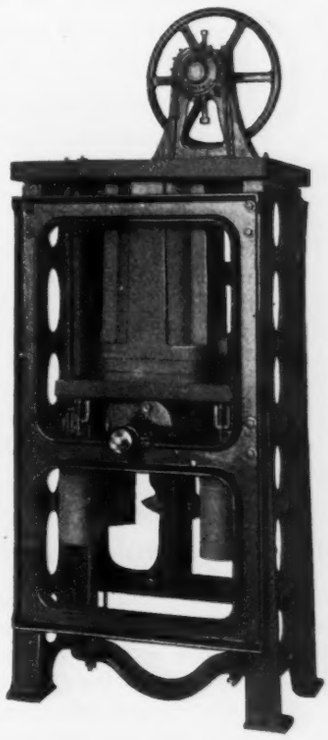

FIG. 2—MOLDING MACHINE FOR DEEP WORK WITH PATTERN LOWERED OUT OF MOLD

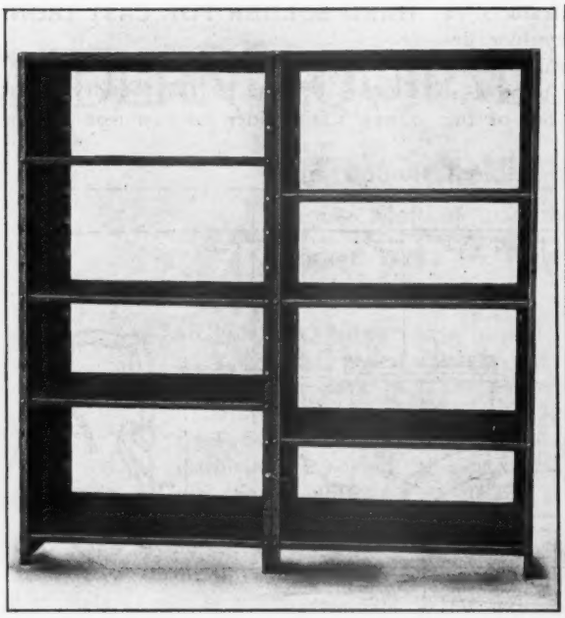

FIG. 1—STEEL RACKS FOR PATTERN STORAGE

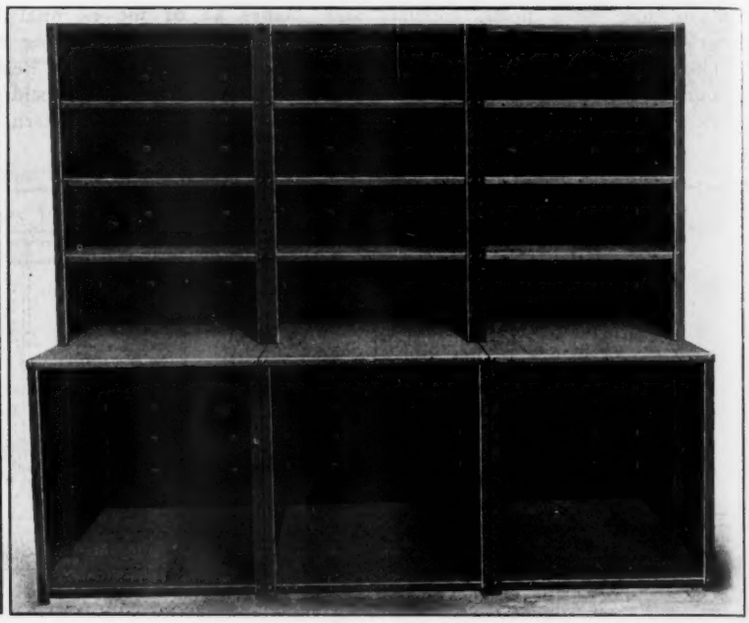

FIG. 2—STEEL PATTERN STORAGE SHELVING PROVIDED WITH STEEL BACKS

faces should be thoroughly cleaned with a wire brush, and if the fracture is greasy the grease should be burnt off or the surface dipped into muriatic acid. The solder is applied to both pieces of the fracture, and the broken parts of the section are then forced together and clamped, or held by a wire, to prevent their movement in the subsequent operations. The casting is then placed in a slow charcoal fire, and after withdrawing the same, the fracture is covered with powdered borax. To the upper side of the fracture, hard brass solder of medium fluidity, or pure brass filings are placed, on which additional borax is sprinkled. The casting is then returned to the charcoal fire and is heated until red. This melts the solder, which should be gently rubbed into the fracture with a bent wire, after which the casting is carefully withdrawn from the fire. Detailed instructions for using this solder, as well as illustrations of large castings repaired by this process, are described in a catalog recently issued by R. F. Lang.

THE OHIO SAND COMPANY.

The Ohio Sand Co., Conneaut, O., miner and shipper of all grades of molding sand, has withdrawn the sale of its product from the Interstate Sand Co., Cleveland, and is again selling its sand direct to the foundry trade. The Ohio Sand Co. has banks at Conneaut, Kingsville, Shinrock, Crystal Springs and New Cumberland, O., as well as at Girard, Pa. F. E. Gordon is president of this concern.

STEEL SHELVING FOR PATTERN STORAGE AND FOUNDRY USE.

The advantages of steel shelving in pattern storage buildings are becoming more generally recognized, inasmuch as the fire hazard is reduced to the minimum, and in addition there is an economy of space, as steel shelving requires but a fractional part of the thickness of wood shelving to have an equivalent strength. In addition, steel shelving permits of the interchangeability of the different racks and shelving systems, which is not possible when wooden shelving is used. Furthermore, being sectional in construction, any width or height can be obtained.

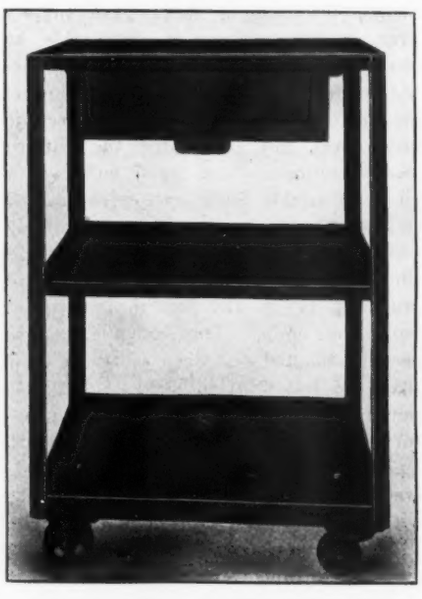

FIG. 3—PORTABLE STEEL RACK FOR SHOP USE

The Terrell's Equipment Co., Grand Rapids, Mich., is manufacturing pattern storage racks, bin racks for die and tool storage, as well as portable tool racks, trays and boxes provided with roller casters and with one or more shelves. In Fig. 1 are illustrated two sections of the regular pattern storage rack. The end uprights are made of No. 20 gage steel riveted to two strips of 1 x 1 x ⅛-inch reinforced angles. At the front the uprights are provided with holes for ¼-inch bolts, the vertical distances between the holes being 3¼ inches from center to center. In the back of the uprights the angles are provided with catches stamped in them and located opposite the holes in the front. By this means, rapid adjustment of the shelving is made possible, the space between the various shelves being adjustable to suit the patterns stored upon them. The standard sizes of the uprights for this type of shelving are from 12 to 30 inches wide, and from 3 to 15 feet high. Storage shelving, provided with backs, is shown in Fig. 2. These backs are made of No. 18 gage steel and catches are stamped in the backs corresponding to the holes and catches in the uprights. This construction insures a close contact between the shelves and the backs, so that no material can fall down be-

tween. The shelves are made from 24 inches to 40 inches long, the width corresponding to that of the uprights. They are flanged on the sides and ends, and the front and back edges are double folded. In addition, the front edge is reinforced with a strip of ¾ x ¾ x ⅛-inch angle, which is placed inside the fold. In Fig. 3 is shown a portable rack which is made with or without the drawer. The corner posts of this rack are made of angles and the trays of No. 16 gage steel, double folded at the top edges, and attached to the corner post with set screws, so that the rack can be easily taken apart and assembled. The drawer is made of No. 18 gage steel and is attached to the bottom of the top tray by a steel slide.

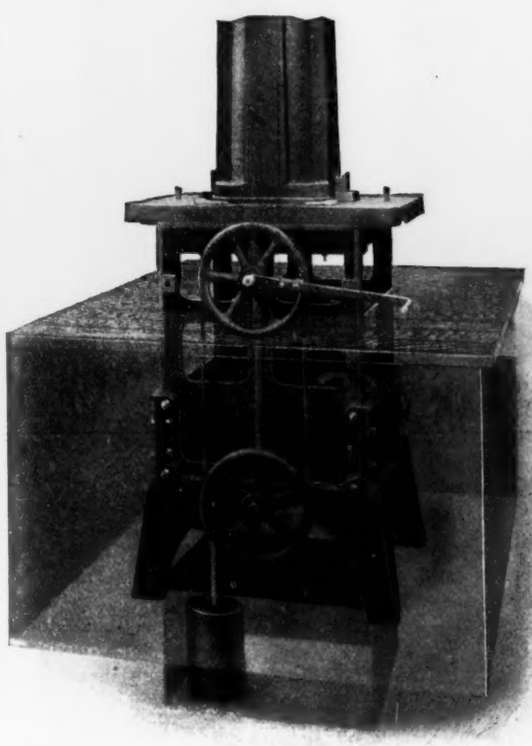

FIG. 1—MOLDING MACHINE WITH PATTERN ELEVATED IN MOLDING POSITION

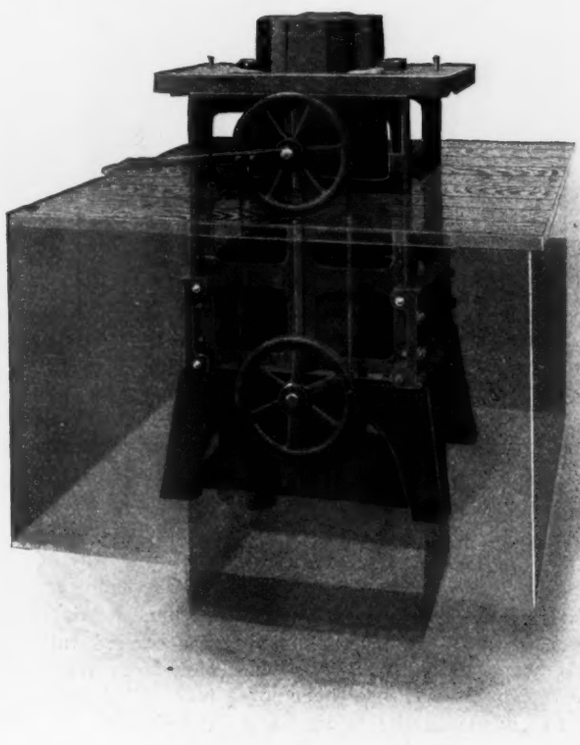

FIG. 2—PATTERN LOWERED STRIPPED OUT OF THE MOLD

DROP PLATE AND STRIPPING PLATE MOLDING MACHINE.

A drop plate and stripping plate molding machine, designed for deep draws, built by the J. D. Smith Foundry Supply Co., Cleveland, is shown in Figs. 1 and 2. In Fig. 1 the pattern is elevated in molding position, and in Fig. 2 it has been stripped through the table out of the mold. The pattern is counterbalanced with two weights, which are lowered when the pattern is raised, as in Fig. 1, and are elevated when the pattern is lowered, Fig. 2. The pattern is actuated by a lever attached to the upper sheave, which is connected with the lower sheave by a wire rope. This machine has a maximum draw of 16 inches, and is especially adapted for deep floor work. Special machines for deeper draws can be built as desired.

WELDED CHAPLETS.

The Shanafelt Mfg. Co., Canton, O., manufacturer of pattern shop and foundry supplies, is now manufacturing welded double head chaplets. Owing to the fact that the plates are welded to the stem it is absolutely impossible for them to slip down over the stem, as is sometimes the case when the plates are riveted. The plates are not punched as when they are riveted, and it is impossible for them to slip down over the stem. Being welded, the chaplet is practically one piece when finished. These chaplets are made in all diameters from ¼-inch to ¾-inch inclusive, and in any lengths, and are fitted with any size plates, square or round, as may be required by the trade. In addition to welding the plates to the stem the latter are made rough, the object of this being to key the stem into the casting in the event of the plate part of the chaplet being planed off. One of these chaplets for which a patent has been applied, showing the corrugations in the stem, is shown in the accompanying illustration. The plant of the Shanafelt Mfg. Co. has been equipped with especially designed electric welding machines for making these chaplets, and in addition this concern makes single head chaplets, pressed tin chaplets, etc. Among other foundry and pattern shop supplies manufactured are the following: Casting brushes, steel cement, bellows, snap flasks, leather and wood fillets, pattern letters, brass and wood

THE SHANFELT WELDED CHAPLET

FIG. 1

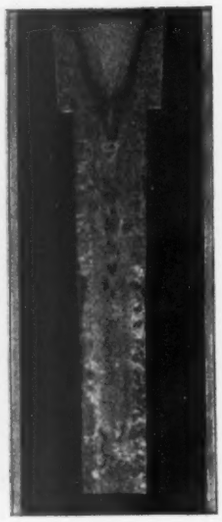

FIG. 2

FIG. 3

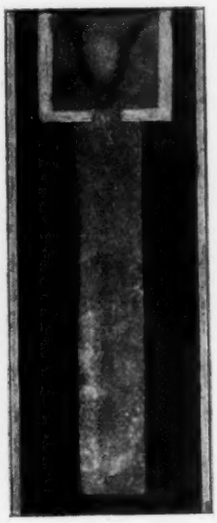

FIG. 4

dowels, rapping plates, lifting screws, fiber glue brushes, corrugated steel fasteners, pinch dogs, etc.

THE ACME GRAPHITE CO.

The Acme Graphite Co., 149 Broadway, New York City, has been organized to engage in the mining and refining of flake graphite. The mines of the company are located in Pennsylvania, and shipments can be made over the Reading and Pennsylvania railroads. The officers of the company are as follows: Willard H. Brownson, rear admiral, United States navy, retired, president; Robert M. Catts, vice president and general manager; M. G. Seckendorff, secretary and treasurer. Geo. H. Hooper is superintendent of the mines, and A. Walter Newbold is sales manager.

FIG. 5

LINED RISER POTS.

To take care of the shrinkage of castings, whether made of iron, steel or the non-ferrous metals, risers of various forms are used. If the risers are carried full size to the castings, blow-holes result and a heavy expense is entailed in removing the head. If the riser has a contracted end or neck, unless large, the metal freezes in the neck and shrinkage holes result. If the neck is large enough to prevent freezing, the chances of piping are increased, and an additional expense is entailed in removing the head.

Edwin C. Washburn, Washburn Steel Castings & Coupler Co., Minneapolis, has devised a riser pot lined with refractory material, which overcomes shrinkage difficulties, and at the same time the riser has a contracted neck so that it can be easily taken off. These riser pots are used successfully in many steel foundries, eliminating shrinkage difficulties, and at the same time the cost of removing the heads is materially reduced.

Figs. 1 and 2 show the shrinkage of metal in ingots. Fig. 1 is an ingot casting without a head and it is piped nearly its full length. The same ingot, Fig. 2, cast with a riser gives only a small pipe or shrinkage hole, but not altogether a sound casting, and its removal entails considerable expense. The same ingot cast with a contracted neck riser is shown in Fig. 3. The metal is frozen in the neck, cutting off a further flow to feed the casting, resulting in a shrinkage hole. The same ingot, cast with a lined riser head, is shown in Fig. 4. This type of head produces a sound casting, and the small neck can be removed with a sledge.

A casting with a heavy riser having a contracted neck is shown in Fig. 5. The cold sand freezes the metal in the neck and cuts off the metal supply. Fig. 6 shows a casting made with the riser pot. The bottom of the riser is surrounded with molten metal so that it cannot chill, and permits the metal in the head to feed the casting, thus eliminating shrinkage difficulties entirely.

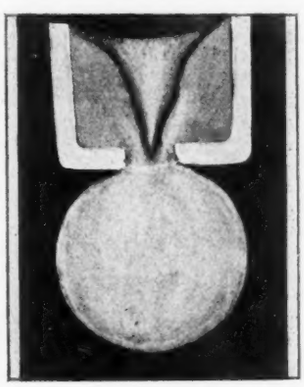

FIG. 6

The six numbers of the *Obermayer Bulletin*, published during 1909, have been handsomely bound in a red cloth cover, and will be furnished by the S. Obermayer Co., Cincinnati, at a price of 60 cents.

TRADE NOTES.

The Manufacturers' and Merchants' Association, Rome, Ga., is sending to the trade a booklet containing illustrations of the industries of that city. Iron ore is mined at 23 points within 25 miles of this city, and it is the largest stove manufacturing center in the South, three stove foundries being located there.

The annual conference of sales managers and agents of the Ingersoll-Rand Co. was held in New York City and at the company's shops, from Feb. 1 to 5 inclusive. The meetings were presided over by W. L. Saunders, president, and other executive officers in attendance included: George Doubleday, J. P. Grace and Geo. R. Elder, vice presidents; W. R. Grace, vice president and treasurer; F. A. Brainerd, secretary, and Henry Lang, director. Foreign representatives of the company in attendance included the managers of the London, Paris, Milan, Mexico City and Montreal offices.

The Electric Smelting & Aluminum Co., Lockport, N. Y., manufacturer of aluminum, alloys of aluminum, silicon-copper, manganese-copper, manganese-copper and special alloys, is sending to the trade a calendar containing a half-tone reproduction of its works at Lockport, N. Y.

The Standard Sand & Machine Co., Cleveland, is sending to the trade a pamphlet entitled "The Selection and Preparation of Molding Sand." It points out the most essential properties required in molding sand and outlines the method of preparing the sand to obtain the best results in foundry practice.

The J. W. Paxson Co., Philadelphia, is sending to the trade a handsome calendar which contains a colored lithograph, entitled the "Quaker Maid."

C. W. Leavitt & Co., 30 Church street, New York City, are sending to the trade a reprint of an article entitled "The Girod Electric Furnace and the French Works Using the Paul Girod Steel Process," which was presented before the American Institute of Mining Engineers.

The *Obermayer Bulletin*, published by the S. Obermayer Co., Cincinnati, will hereafter appear monthly instead of bi-monthly, as in the past.

The Brown Bros. Mfg. Co., Twenty-second street and Campbell avenue, Chicago, has recently installed a diamond pattern lumber machine, and is now producing from 150 to 200 pieces of diamond pattern lumber per day. Prompt shipment of this material in small and large lots can be made by this concern.

BOOK REVIEWS.

The Foundry Data Sheets.—Penton Publishing Co., Cleveland, 5½ x 9 inches, 60 pages. Supplied by THE FOUNDRY for $1.

Data sheets of foundry practice, which have appeared from month to month in THE FOUNDRY during the past three years, have been bound in a loose-leaf binder. This binder makes it convenient to insert additional data sheets as they appear in THE FOUNDRY. These data sheets, 60 of which have already appeared, contain valuable specifications, tables, etc., which are useful to foundrymen, as well as engineers. The standard specifications thus far published include specifications for foundry pig iron, malleable castings, gray iron castings, steel castings, cast iron car wheels, locomotive cylinders, cast iron pipe and special castings, and standard methods for determining the constituents of cast iron. Numerous formulae are also included for finding the weights of iron castings, as well as methods of calculating mixtures for the cupola.

How to Make Converter Steel Castings, by Arthur Simonson. Penton Publishing Co., Cleveland, 6 x 9 inches, 22 illustrations. Supplied by THE FOUNDRY for 75 cents.

This work, in six chapters, is a comprehensive discussion of the methods involved in the manufacture of steel castings by the converter process. The construction of the converter, as well as the location of this vessel in relation to the cupola, is described, and instructions are given for lining. Both arithmetical and graphic methods of calculating the cupola charges are given, as well as the analysis of the iron which is to be converted into steel. One chapter is devoted entirely to the operation of the converter, which includes the blowing of the steel and many valuable suggestions are given for overcoming difficulties during the period of the blow. Hot cracks in steel castings are discussed in another chapter, and the steel foundry laboratory likewise receives considerable attention. This book is compiled from a series of articles which appeared in THE FOUNDRY.

Methods of Chemical Analysis and Foundry Chemistry, by Frank L. Crobaugh; 5 x 7 inches, 109 pages. Furnished by THE FOUNDRY for $2.00.

The second edition of this work contains some slight modifications and changes. The chemical methods described in detail are those which, after a critical study of texts and papers to which the author has had access, seem best adapted to rapid work without the sacrifice of accuracy. The book is divided into two parts, the first part describing methods of making chemical analyses, and the second part contains instructions for the calculation of mixtures, as well as discussions of white and chilled castings, malleable castings, chilled rolls, car wheels, machinery castings, etc.

PACIFIC NORTHWEST FOREMEN MEET AT PORTLAND AND SEATTLE.

Two interesting meetings of the Pacific Northwest Foremen's Association have been held recently, the first at the Commercial Club Building, Portland, Ore., February 4, and the second at the Chamber of Commerce, Seattle, February 12.

At the Portland meeting, A. M. Clark of the Columbia Steel Co., read an interesting and instructive paper on "Steel." He detailed clearly the salient features of the different processes of steel-making, laying particular stress on the manufacture of steel castings.

At the Seattle meeting J. H. Linton of the Pacific Coast Testing Laboratory, Seattle, gave a talk on "Chemistry," particularly as applied to foundry practice. Mr. Linton outlined some of the basic laws of chemistry and explained their application in foundry work. He said that a chemist, to be valuable in a foundry, must not only have an intimate knowledge of chemistry and quantitative analysis, but a thorough acquaintance with foundry practice as well.

MIXTURE FOR HARD BRASS BUSHINGS.

Question:—We are anxious to secure a mixture for bushings, which are used on machines for making cigarettes. These vary from 2½ to 4½ inches in diameter and are from 6 to 8 inches long. The machines are operated at high speed, and the manufacturer complains that the bushings wear out too rapidly. We presume a hard mixture is preferable for this kind of work.

Answer:—An alloy that can be recommended for this class of work, follows: Copper, 82 pounds; tin, 10 pounds; phosphor tin (5 per cent), 2 pounds; lead, 6 pounds. This is one of the most expensive alloys, and will probably prove too costly for your work. The following may be tried: Copper, 66 pounds; lead, 14 pounds; zinc, 10 pounds; tin, 4 pounds.

K. K.

TRADE PUBLICATIONS.

COAL.—The Columbus Iron & Steel Co., Columbus, O., has published a unique pamphlet, handsomely illustrated, which is devoted to a description of Olive coal. The company's mining operations at Marting, Fayette county, W. Va., are shown by half-tone illustrations, and the coking operations are likewise described. All of the coke produced is used by this concern for operating its blast furnaces at Columbus, in the production of all grades of foundry iron.

FUEL ECONOMIZERS.—The B. F. Sturtevant Co., Hyde Park, Mass., in catalog No. 150, containing 40 pages, describes the new Sturtevant, high pressure type, fuel economizer. This has metal to metal joints, will withstand pressures up to 300 pounds per square inch, and as no gaskets are used all chance of leakage has been eliminated. As it is of great importance to keep the economizer pipes clean, and to prevent the accumulation of soot on the pipes, which prevents the proper transmission of heat, these economizers have been provided with automatic pipe scrapers, that are moved up and down the pipes by a geared, belt-driven mechanism, which acts positively and keeps the pipes clean. The soot drops to the bottom of the economizer and is readily removed through the cleaning doors. The catalog, in addition to a large number of views of installations of fuel economizers and air heaters, contains tables of sizes of standard economizers built by this concern, efficiency of fuels, properties of saturated steam, and other interesting data which will prove useful to engineers, managers and owners of power plants.

SAND BLAST.—The Pangborn high pressure sand blast is described in bulletin No. 101, issued by the Thomas W. Pangborn Co., 90 West street, New York City. This device is equipped with an air separator, which extracts all moisture and oil from the compressed air before it comes in contact with the sand. This machine is made in 10 sizes, in capacities from 500 to 6,000 pounds. Bulletin No. 102, issued by this concern, describes two sand dryers, which are adapted for drying all grades of sand for foundry use.

FANS.—The American Blower Co., Detroit, in bulletins Nos. 263 and 264, describes steel plate and cone fans. The exhaust fans, although built with the inlet on the opposite side from the pulley or engine, when necessary are built as blowers with inlets on both sides. The bulletin on exhaust fans contains speed capacity and horsepower tables, as well as other interesting data for the engineer. The cone fans, ordinarily intended for exhausting air from buildings, are sometimes employed as plenum fans, discharging into chambers from which ducts radiate. In addition, the American Blower Co. describes its line of steam traps in bulletin No. 267, while bulletin No. 265, which contains 76 pages, is devoted to dry kilns for timber products.

"FERROINCLAVE."—The Brown Hoisting Machinery Co., Cleveland, in a 40-page catalog, describes "Ferroinclave," and many illustrations of its wide application are included. This material is made of sheet steel with dovetail corrugations, which are inversely tapered, thus permitting the large ends of the corrugations of one sheet to fit or "shingle" over and into the small ends of the corrugations of another sheet, thus forming a tight joint without destroying the dovetail of the corrugations, and making practically one continuous sheet. It is used as a reinforcement for concrete roofs, floors, side walls, partitions, highway bridges, culverts, tanks, etc. As a roofing material it is especially desirable for foundry buildings, in view of its fireproof nature, and numerous illustrations are contained in this catalog showing the roof and side walls of the Superior Foundry Co., Cleveland, which were constructed with this material.

OXHYDRIC PROCESS. — The American Oxhydric Company, Milwaukee, in a 24-page booklet recently issued, illustrates and describes the oxhydric process for the cutting and welding of metals. This concern has acquired the American and Canadian patents for the manufacture of oxygen and hydrogen by the Garuti system; the process and apparatus for autogenous welding of metals with the aid of the oxygen and hydrogen flame; the process and apparatus for the cutting of metals by the oxhydric method; the safety mixing apparatus for gases, together with a number of other patents on special devices applying to this work. This process can be used for repairing light and heavy castings, which have become defective as the result of blow-holes, sand holes, etc., and cracked or broken castings, whether aluminum, brass, bronze, cast iron or steel can be welded together. In addition, steel and wrought iron, ranging from 12 to 20 inches in thickness, can be cut by this flame.

GRAPHITE AS A LUBRICANT.—The Joseph Dixon Crucible Co., Jersey City, N. J., has recently issued the 11th edition of "Graphite as a Lubricant." This is a treatise upon the theory of graphite lubrication and has been thoroughly revised and brought fully up-to-date. The present edition is more compact than its predecessor, the idea being to concentrate the information in convenient form for ready reference. The power house engineer will find this edition of considerable value to him, since it deals especially with the lubrication and treatment of power house machinery. The book is well-arranged, well-printed and handsomely illustrated.

ANNEALING FURNACES.—The Rockwell Furnace Co., 26 Cortlandt St., New York City, is sending to the trade an 8-page circular illustrating and describing briefly its line of annealing, hardening and tempering furnaces. A miscellaneous line of heating furnaces are also illustrated, including annealing furnaces for brass rolling mills, steel casting plants, for annealing steel sheets, etc.

IRON, STEEL AND MACHINERY STOCK LIST.—Joseph T. Ryerson & Son, Chicago, have issued a 380-page stock list of iron, steel machinery and allied specialties, which are carried in the warehouses of this concern. In addition to tables of sizes of finished iron and steel products of all kinds, this booklet contains valuable information for engineers, architects, contractors, structural iron and die metal workers, and users of machinery in general.

INSULATION OF PIPES AND BOILERS. —The H. W. Johns-Manville Co., 100 William street, New York City in a 24-page booklet, illustrates and describes its complete line of asbestos, magnesia, wood felt, as well as corrugated fire-proof paper, sectional pipe covering. Asbestos and magnesia insulating cements for insulating boilers are also shown. In an 8-page folder issued by this concern, the saving that can be effected by the use of these pipe coverings is graphically shown.

METAL MELTING FURNACES. — The Monarch Engineering & Mfg. Co., Baltimore, Md., in a 32-page catalog, describes its extensive line of crucible tilting furnaces for melting ferrous and non-ferrous metals, ladle heaters, core ovens, mold dryers and portable heaters for lighting cupolas. The crucible tilting furnaces are adapted for melting and refining foundry metals, both ferrous and non-ferrous, including brass, bronze, copper, nickel, aluminum, tin, lead, ferro-alloys, manganese, silicon, vanadium, iron, etc. Among the furnaces shown is one of the pre-combustion tilting type, which is arranged with a supplementary rear chamber for receiving the flame from the burner, and which is deflected against a baffle block. An article on the use and abuse of crucibles contains pertinent information regarding the handling of pots, and should prove of interest to every foundryman. In addition, formulas of standard foundry mixtures are also included.

SAND PREPARING EQUIPMENT. — The Standard Sand & Machine Co., Cleveland, in catalog No. 5, containing 28 pages, describes its extensive line of sand mixers and sand preparing plants for installation in foundries. Various types are shown adapted for both small and large foundries, and the continuous plant illustrated for proportioning, pulverizing, screening, mixing and tempering core or facing sand, has a capacity of from 12 to 15 tons per hour. Other devices shown include an automatic oil spraying device, centrifugal sand mill, stationary pulverizer, portable pulverizer and sand tempering machine, adjustable, portable power screen, etc. In addition, this concern is engaged in mining and shipping molding sands for all classes of foundry work. These molding sand plants are located at Everett, Sherrodsville, Cumberland and Somerdale, O.

SAND BLAST.—The Niagara Device Co., Buffalo, is sending to the trade a six-page folder describing its sand blast equipment and paint spray. A list of users of both these devices are included.

MOLDING MACHINES. — The Rowlands Machine Co., Racine, Wis., has issued a 32-page catalog describing its line of "Simplex" molding machines. These machines are of the hand-ramming, stripping plate type, and are made in various styles and sizes for the various classes of work for which they are adapted. Machines fitted for various classes of work, including brake shoes, shaft couplings, automobile cylinders, truck wheels, sad irons, pumps, draw bars, truck frames, etc., are shown, and many different cylinder castings molded on these machines are illustrated. A portable molder's bench, made of cast iron, and which is adjustable to any height to suit the molder, is also described. This bench contains many conveniences for the bench molder and is mounted on four wheels.

TURBINES.—The Kerr Turbine Co., Wellsville, N. Y., has issued two new bulletins, Nos. 9 and 10, entitled "Turbo-Blower Units" and "Steam Turbine Generators and Centrifugal Pumps." Bulletin No. 9 illustrates units for forced and induced draft, gas works' service, as well as for furnishing blast for cupolas. The other bulletin illustrates and describes generating sets for electric power and lighting, pumping units for boiler feed, fire service, water supply, circulating condenser water, drainage pumps, and for other service where water must be delivered at moderate or high pressure, or against considerable head.

AIR COMPRESSORS.—The American Air Compressor Works, Brooklyn, N. Y., in an 8-page circular, describes its line of "Fairhurst" air compressors, vacuum pumps, pneumatic tools, air receivers and air lift well pumps. Dimensions of various sizes of air compressors are given, as well as a brief description of their construction and instructions regarding their installation and operation.

EXHAUST FANS.—The American Blower Co., Detroit, in bulletins Nos. 271 and 272

illustrates and describes cast iron exhaust fans as well as the Dixey exhaust fan. The bulletin on cast iron exhaust fans shows their application for the removal of dust from emery wheels, and valuable suggestions are given regarding the installation of this equipment.

PYROMETERS.—The Sarco Fuel Saving & Engineering Co., 90 West street, New York City, in bulletin No. 3 describes its line of pyrometers and gives valuable suggestions for their use in foundries.

PUMPS. — Henry R. Worthington, 115 Broadway, New York City, in bulletins Nos. 175 and 176, illustrates and describes turbine pumps for high head service and centrifugal pumps for low head service. Many illustrations of the application of turbine pumps are given in bulletin 175, as well as details of their construction and directions for installing and operating the same. In bulletin No. 170, the application of centrifugal pumps for various services is illustrated and directions for installing and operating the same are also included.

FLASK - STRIPPING MOLDING MACHINE.—The Osborn Mfg. Co., Cleveland, in a 16-page catalog, illustrates and describes the Osborn adjustable flask-stripping molding machine. This machine is adjustable to any size of flask and eliminates the use of stripping plates. The machine, which has a maximum pattern draw of 6 inches, is made in three sizes, while another machine of a similar type, having a 10½-inch draft, is made in two sizes. Another machine of this style is designed to be placed in a pit, the drawing table and flask supports being set at any desired height above the floor level. This is especially adapted for copes requiring a long pattern draw, such as transformer boxes. A special cope stand is also shown for use with the adjustable flask-stripping machines.

SNAP FLASKS.—Baldwin, Tuthill & Bolton, Grand Rapids, Mich., in catalog No. 12, containing 240 pages, illustrate and describe their line of steel, self-releasing snap flasks intended for bench and machine molding. A bench flask outfit consists of cope and drag flasks and six jackets. This concern is also a large manufacturer of saw and knife filing machinery and other wood-working tools. An extensive line of band saw sharpeners are illustrated, as well as numerous types of grinders.

General Industrial Notes

The National Sanitary Mfg. Co., Salem, Ohio, has increased its capital from $200,000 to $300,000.

The Adamson Machine Co., Akron, Ohio, has completed its new foundry, which consists of a machine shop and foundry, 80 x 160 feet, and a blacksmith shop, 40 x 80 feet. The machine shop and foundry are commanded by 15-ton electric cranes.

The foundry of the General Castings Co., Verona, Pa., was sold recently at receiver's sale, to the Standard Steel Car Co., Pittsburg, for $235,000. The melting equipment of this plant consists of three open-hearth furnaces, which will be placed in operation shortly. The foundry will furnish steel castings for the various car plants of the Standard Steel Car Co.

The Kewanee Foundry & Mfg. Co., Kewanee, Ill., has been organized with $40,000 capital, to take over the business of the Iowa Novelty Co., Burlington, Ia.

The new plant that is being erected by the Getz and Floding Mfg. Co., Chicago, is nearing completion. This brass foundry is being built at Clybourne avenue and Willow street.

The Valley Foundry Co., Canal Dover, Ohio, recently organized, will engage in the manufacture of aluminum and brass castings.

The new steel foundry operated by the Deemer Steel Castings Co., New Castle, Del., has been placed in operation. S. S. Deemer is president and general manager.

The Titan Steel Casting Co. has purchased the plant of Benjamin Atha & Co., Newark, N. J. The foundry will be operated as in the past and special attention will be given to the production of cast steel bolsters, manganese steel motor gears, pinions, etc.

The new plant of the Central Foundry & Machine Co., Marion, Ind., was recently placed in operation. The main building is 80 x 290 feet. Addison Meyer is superintendent of the foundry.

The plant of the Delphos Foundry & Mfg. Co., Delphos, Ohio, has been sold to the Contractor's Supply Co., Lima, Ohio. The new company is capitalized at $50,000, and has the following officers: President. W. T. Agerter; vice president, George Feltz; general manager, C. L. Moore; secretary-treasurer, A. C. Phelps.

The Illinois Malleable Iron Co., Chicago, is building a new foundry, 470 x 164 feet. When the addition to this plant is placed in operation, this concern will have an annual output of 30,000 tons of castings, the metal being melted in six air furnaces of 16 tons capacity each. Additional annealing ovens will be installed in a one-story brick addition that is under way, and a six-story warehouse, 150 x 80 feet, is also being built.

The directors of the Altoona Foundry & Machine Co., Allegheny Furnace, Pa., have decided to sell the plant, which has been idle for several years.

The Connecticut Mfg. Co., recently incorporated at Waterbury, Conn., will engage in the manufacture of brass castings, and an electro-plating plant will also be installed. The officers are: Chas. Swenson, president and treasurer; John Swenson, secretary, and Chas. H. Swenson, general manager.

The Machine-Molded Brass Casting Co. has established a plant at 285 South street, Boston, Mass., for the manufacture of brass castings by a special process.

New Construction.

The Crawford & McCrimmon Co., Brazil, Ind., will erect a new brass foundry for the production of castings for hoisting engines, pumps and fans.

The Racine Aluminum & Brass Foundry, Racine, Wis., is now occupying its new plant which is 40 x 100 feet.

The Mitchell & Van Meter Co., manufacturer of plumbers' brass goods, will build a new plant at Thirteenth and Cumberland streets, Philadelphia. A new plating plant and a brass foundry will be located on these premises.

Shaffer Co., Harrisburg, Pa., will build a new brass foundry, 100 x 120 feet, for the manufacture of brass specialties for automobiles.

The Acme Malleable Iron Works, Buffalo, will shortly begin the erection of an addition to its foundry, and specifications covering the equipment will be issued early in March.

The Peerless Motor Car Co., Cleveland, has awarded contracts for erection of a new foundry, 50 x 180, three stories high. The first floor will be used for metal storage, the second for the core room, and the third as the molding department for aluminum and brass castings.

The American Roll & Foundry Co., Canton, O., is increasing its foundry capacity by the erection of a steel and brick building, 100 x 130 feet, in which a 40-ton electric traveling crane will be installed. The molding equipment will consist of several air furnaces, and mold drying ovens will also be added.

The Ohio Crucible Steel Castings Co., Cleveland, will extend its plant by the addition of another 8-pot furnace and the installation of a side-blow converter.

The Moline (Ill.) Foundry Co., will erect an addition to its plant, 40 x 100 feet.

The Albion Malleable Iron Co., Albion, Mich., is building a new annealing room, 150 x 300 feet, and a pattern storage building 60 x 120 feet.

The Vulcan Iron Works, New Britain, Conn., is building a foundry, 110 x 203 feet, which is rapidly nearing completion. An air furnace will be installed.

The Phoenix Iron Works, Portland, Ore., is operating a jobbing foundry, the capacity of which will shortly be considerably increased.

The Peninsular Stove Co., Detroit, contemplates the erection of a new plant, which will probably include a large malleable and gray iron foundry.

The Long Mfg. Co., Detroit, is erecting a new plant at Cass and Amsterdam avenues, which will include a foundry, 32 x 85 feet.

French & Hecht, successors to the Bettendorf Metal Wheel Co., Davenport, Ia., will erect a three-story foundry building, which will have a total area of about 150,000 square feet. The building will be of reinforced concrete construction and the equipment throughout will be modern. The top floor will be devoted to melting entirely, while the lower floors will be used for pattern storage, coremaking, etc.

The Wilmington Malleable Iron Co., Wilmington, Del., is preparing to increase its melting facilities by the addition of four air furnaces. The plant already has six air furnaces in operation, and its output will be greatly increased by the addition of the furnaces noted.

The Cascade Foundry Co., Erie, Pa., is contemplating a further addition, 100 x 80 feet, to the main building of its foundry.

The Talladega Foundry & Machine Co., Talladega, Ala., whose plant was recently destroyed by fire, will rebuild at once.

The Tarrant Foundry Co., Chicago, is building a new plant at Seventeenth and Robey streets, and will soon abandon its old shop at Indiana and Kingsbury streets, which has been operated for 26 years. The main foun-

dry building is 200 x 140 feet, of steel, concrete and brick construction. The center span is 60 feet wide and will be served by a 15-ton traveling crane. One of the side bays will be 45 feet wide and will be served by a 10-ton crane. Another bay, 28 feet wide, will be commanded by a 5-ton crane. The cupola charging floor parallels an elevated spur track and is at car height, thus eliminating the lifting of material. The pig iron will be delivered directly from the cars to the stock piles on the charging floor through 11 steel rolling doors. From the elevated track, sand will also be delivered to the stock bins on the foundry floor level. The melting equipment will consist of two cupolas, 66 and 84 inches in diameter, respectively, and the blast will be furnished by motor-driven positive pressure blowers. An elevator has been provided for conveying scrap and defective castings to the charging floor. Two core ovens, 7 x 18 feet and 9 x 18 feet, will be installed, as well as a mold drying oven, 15 x 27 feet. The cleaning house will be 30 x 55 feet and 16 x 16 feet. The foundry yard will be commanded by a traveling crane of 15 tons capacity, having a span of 55 feet 8 inches. The pattern and office building will be of reinforced concrete, three stories high, 50 x 56 feet. The plans have been prepared by Raeder & Wood, Chicago, and the estimated cost of the buildings is approximately $100,000.

The Lorenson Mfg. Co., Rock Island, Ill., will shortly award contracts for a new foundry, 40 x 60 feet.

The Vulcan Iron Works, New Britain, Conn., is erecting a new foundry, 110 x 203 feet.

The Kewanee Boiler Co., Kewanee, Ill., will increase the capacity of its plant by the erection of five buildings, including a foundry, radiator cleaning department, storage department, machine and boiler shops. The foundry and machine shop will be 80 x 432 feet, and will be commanded by a crane having a 40-foot span. The radiator cleaning room will be 80 feet square, and the storage warehouse will have the same dimensions.

The Murphy Iron Works, Detroit, will erect a foundry, 125 x 500 feet, for the production of gray iron and malleable castings.

The Prime Steel Co., Milwaukee, is preparing to erect a large addition to its plant to provide for increased melting facilities, consisting of a 20-ton open-hearth furnace. A large core room will also be built.

The Velte Foundry & Machine Co., Pittsburg, has sold its property and has purchased seven acres of land at Mars, Pa. A new plant will be built on this site consisting of a foundry, 60 x 200 feet, and a machine shop, 40 x 100 feet. The foundry will be equipped with a converter for the production of steel castings, as well as two cupolas. The foundry will be commanded by two 15-ton cranes.

The Hubbard Steel Foundry Co., Chicago, recently organized, with a capitalization of $300,000, has purchased the Davidson Foundry Co.'s plant at East Chicago, and two 30-ton open-hearth furnaces for the production of steel castings will immediately be installed.

The Grant Bros. Foundry, Detroit, is erecting a new plant for the production of gray iron, brass and aluminum castings for automobile work.

The Cream City Foundry Co., Milwaukee, recently organized, is now awarding contracts for its equipment.

A new plant will be built during the spring by the Kittler Brass Mfg. Co., Houston, Tex.

The Enterprise Foundry & Fence Co., Indianapolis, has purchased the property of the Mainland Mfg. Co., Twenty-fourth and Yandes streets, and will erect a new plant on this site. This property is 400 x 650 feet.

The Fort Pitt Steel Casting Co., McKeesport, Pa., is erecting an addition to its foundry. This concern makes a specialty of small steel castings.

The Big Four railroad is preparing plans for a new plant to be erected at Beach Grove, near Indianapolis, and the new buildings will include a foundry, 134 x 264 feet, and pattern storage building, 64 x 190 feet. Wm. Garstang is superintendent of motive power, with headquarters at Indianapolis.

The Chandler & Price Co., Cleveland, manufacturer of printing presses, will soon begin the erection of a foundry and power plant, plans for which have been prepared by the Cleveland Engineering Co. The new building will be 50 x 200 feet, three stories high. The first story and basement will be used for storage purposes, the second story for cleaning castings, coremaking and for the pattern shop, and the molding department will be located on the third floor. Molding machines will be used on all of the work that can be made in this way, and two elevators will be installed in the foundry.

The Marion Stove Co., Marion, Ind., is erecting a two-story addition to its plant, 50 x 100 feet.

The Moline Foundry Co., Moline, Ill., will begin the erection of an addition to its foundry, 40 x 100 feet, within the next few months.

The Brandin Machine Works Co., Ltd., Brandon, Minn., has increased its melting equipment by the installation of another cupola, and has increased its foundry by the erection of an addition 40 x 75 feet.

The James A. Brady Foundry Co., Chicago, has absorbed the E. J. Welch Foundry Co., of that city. The two plants will be operated separately but under one management. E. J. Welch will have general supervision of the two foundries.

The Crown Cork & Seal Co., Baltimore, will erect a foundry to produce castings for its own use.

The American Sanitary Mfg. Co., Detroit, will erect a plant at Abingdon, Ill., for the manufacture of plumbers' goods. The brass foundry at Detroit will be dismantled.

The Frankford Brass Mfg. Co., Frankford, Ind., will engage in thte manufacture of brass castings. Berkshire molding machines are being installed. The melting equipment consists of 10 furnaces.

The Union Brass Works, Detroit, has been organized for the manufacture of valves, gas and water fittings, as well as automobile brass goods. The foundry will be 33 x 70 feet.

The Racine Foundry Co., Racine, Wis., has been organized with $40,000 capital to engage in the manufacture of automobile and motor cycle cylinders. This concern will erect a foundry and machine shop, and bids are now being received for the necessary machinery and equipment.

The Ford Motor Co., Detroit, is securing bids on a foundry, 200 x 200 feet, to be erected on Jefferson avenue, between Brush and Beaubien streets.

The Detroit Lubricator Co., Detroit, Mich., will soon award contracts for a new foundry building which it will erect adjoining its plant on Trumbull avenue.

The Aluminum Castings Co., Cleveland, has acquired a site of seven acres in Buffalo, and will erect a new foundry, 120 x 175 feet.

The Dayton Brass Foundry, 916 East Third street, Dayton, O., manufacturer of bearing metal for street cars and railroads, is erecting an addition to its plant, which will practically double the present capacity.

The General Foundry, Pontiac, Mich., will build a plant, 50 x 80 feet.

The Graham Mfg. Co., Racine, Wis., contemplates the erection of an aluminum foundry.

The Portland Foundry & Machine Co., Portland, Ind., has recently placed its new plant in operation. It consists of a gray iron foundry, 80 x 85 feet, drop forge shop, 82 x 100 feet, and a machine shop, 42 x 80 feet.

The Bucyrus Foundry Co., Bucyrus, O., has been incorporated with $50,000 capital, and has taken over the plant of the Ashland Iron Works Co., Ashland, O., which is engaged in the manufacture of gray iron castings. Officers of the new concern follow: President, John Shunk; secretary, D. F. Baumgartner; treasurer, F. E. Donnewirth, and vice president and general manager, C. L. Morkel.

The Hanna-Brackenridge Co., Fort Wayne, Ind., has recently purchased a plant originally occupied by the Clark Fixture Co., of that place. In addition to a machine shop, the plant has a well equipped foundry.

The Wm. O. Lee Co., Port Huron, Mich., has completed a new foundry, 30 x 80 feet. The melting department is 16 x 30 feet and contains eight furnaces. This concern is engaged in the production of brass castings.

The Whitin Machine Works, Whitinsville, Mass., manufacturer of textile machinery, is planning a 100-foot extension to its foundry, which will make it 300 x 200 feet.

The Standard Foundry Co., Hartford, Conn., manufacturer of gray iron castings, has acquired a tract of land in that city upon which a new plant will be built.

The Weir Stove Co., Taunton, Mass., is erecting an addition to its foundry.

The Shull Steel Casting & Mfg. Co., Canton, O., has completed an addition to its plant 100 feet in length, and has installed an additional 25-ton furnace.

The Prime Steel Casting Co., Milwaukee, will erect an addition to its foundry, 65 x 140 feet.

The Mansfield Brass Foundry, Mansfield, O., J. H. Berry proprietor, is erecting a new plant, 45 x 161 feet, 60 feet of the length being two stories high.

The Woods-Evertz Stove Co., Springfield, Mo., is erecting a two-story concrete block addition, 25 x 125 feet, which will be used as a pattern shop.

The Schaefer Co., Berlin, Wis., will erect an addition to its foundry, which will be used as a pattern department and pattern storage.

The Co-operative Stove Works, Buffalo, will build a foundry at Amherst street and the New York Central tracks, of brick and stone construction, two stories high, 90 x 97 feet.

The J. M. Kohler Sons Co., Sheboygan, Wis., manufacturer of enameled ware and plumbers' supplies, is erecting a power plant, 110 x 140 feet, and a 200-foot extension to the annealing department is also contemplated.

AS MOLDING MACHINE SALESMAN. Practical foundryman well known in United States and Canada; can sell any kind of foundry tools. Address Box 815, THE FOUNDRY, Cleveland, O.

AS PURCHASING AGENT BY YOUNG man with several years' valuable experience. Will guarantee to reduce considerably the buying expense of any fair sized foundry. Address Box 819, THE FOUNDRY, Cleveland, O.

BUSINESS OPPORTUNITIES.

MODERNLY EQUIPPED FOUNDRY for sale. Owing to the resignation of manager, the owners offer for immediate sale a thoroughly modern and up-to-date foundry. The plant has recently been remodeled and is equipped with every modern appliance, including electric light and power, traveling cranes and pneumatic chippers. The buildings and ground are ample, well located and in every way suited for the business. The plant is in a town of about 10,000—near one of the largest markets for castings in this country. Shipping facilities are excellent and freight rates low. The owners of this property have other large interests and cannot devote any time to the business. A very attractive proposition will be made to the right parties and, if necessary, two-thirds of the purchase price will be carried on deferred payments. Address "S. P. B." care THE IRON TRADE REVIEW, Cleveland, O. I.T.R.

A GOOD OPPORTUNITY IS OFFERED to an experienced foundryman who understands how to make first class gas engine castings. Will rent our foundry to him and we will buy our castings of him to the amount of 150 to 180 tons per year. It is the only foundry in the city, and another factory here needs a large amount of castings. Only those with experience and capital enough need apply. Angola Engine & Foundry Co., Angola, Ind.

FOUNDRY AND MACHINE SHOP near Chicago, for sale. On three railroads with switch tracks from E. J. & E. Belt R. R., Chicago basis of switching rates applies. Main building 75 x 230, 100 H. P. boiler, 75 H. P. engine, 50 ton cupola, crane, core ovens, pattern rooms, heating plant, etc. Cost over $25,000 and is nearly new. Good labor market, cheap rent for help and low R. R. fare to and from city. Possession now. Price $11,500. Address E. Orris Hart & Co., 114 Dearborn St., Chicago, Ill.

AN UNUSUAL BARGAIN. A NEW up-to-date stove plant for sale, 60 floors, established trade of over 15 years, with about 100 styles and sizes of standard Ranges, Cooks and Heaters. Fully equipped; located in one of the handsomest and healthiest cities in the South, and in the Birmingham district. Disagreement between partners as to policy only cause for selling. Address Chas. Van Dyke, Birmingham, Ala.

WANTED, A SPECIALTY TO MANUfacture, and place on the market, in connection with a well equipped foundry making light castings; the right kind of a man to take entire charge. Great opportunity. Address Box 805, THE FOUNDRY, Cleveland, O.

AN EXCELLENT PATTERN JOBBING plant for sale. Write us. Chattanooga Pattern Works, Chattanooga, Tenn.

FOR SALE OR RENT: FACTORY BUILDing, built for foundry and machine shop. Can be easily remodeled for other business. Railroad facilities unexcelled. For further information, address the Franklin Industrial Co., Warwick, O. I.T.R.

INVENTORS, ATTENTION: MERITOrious patented foundry machinery manufactured on royalty basis. Long experience and unexcelled facilities for reaching foundry trade. Whiting Foundry Equipment Company, Harvey (Chicago suburb), Ill.

A PROGRESSIVE GRAY IRON JOBBING foundry desires a cast iron specialty to manufacture to be either machined or unfinished. Address Box 776, THE FOUNDRY, Cleveland, O.

BLOWERS FOR SALE.

BLOWER BARGAINS.

Roots Second-Hand Blowers, bought, sold, or exchanged for new ones. Address,

H. M. PAPWORTH,
120-122 Liberty Street, New York City.

FLUOR SPAR.

FLUOR SPAR—EVERY GRADE, QUOTAtions delivered anywhere. Cheapest suppliers. Address GEO. G. BLACKWELL SONS & CO., Ltd., Liverpool, Eng., or Agents, Penna. Salt Mfg. Co., Pittsburg, Pa.

FOR SALE, MISCELLANEOUS

HAVING INSTALLED MOTORS IN OUR foundry we have for sale one Horizontal Slide Valve Engine, 10 in. x 6 in., complete with governor, fly wheel and drive pulley, and one Enterprise 36 in. blower, both in good working order. Will sell cheap. Address Hermance Machine Co., Williamsport, Pa.

CONVERTERS, CUPOLAS, AND HYdraulic cranes for sale; 3 2-ton converters, 3 extra bottoms, 3 cupolas, blowers, motors, piping; 2 cupola elevators, 4 5-ton hydraulic cranes. Details upon request. Address Titan Steel Casting Company, Newark, N. J.

CRUCIBLE FURNACES DESIGNED AND installed. By years of practical experience in crucible steel castings we have succeeded in determining methods that attain the best results at minimum costs, and are now prepared to furnish complete plans and specifications of furnaces also all data regarding steel and sand mixes for successful operation of crucible steel plants. To parties contemplating the erection of crucible plants, or furnaces in connection with gray iron or malleable foundries, we can refer to plants erected in accordance with our plans now in successful operation. Address Box 810, THE FOUNDRY, Cleveland, O.

A COMPLETE SET OF PATTERNS FOR the manufacture of iron toys, trains, fire departments, stoves, ranges, pistols, etc. etc. The finest line of iron toys on the market. A bargain if taken at once. Reason for selling, manufacturing other lines and cannot give time or room to the manufacture of toys. Address Manufacturer of Toys, care of THE FOUNDRY, Cleveland, O.

NO. 7 CONNERSVILLE BLOWER FOR sale, direct connected to 12 x 12 vertical engine, suitable for cupola of from 60 in. to 72 in. inside the lining. Will melt 16 tons per hour at 120 R. P. M. or 20 tons per hour at 150 R. P. M. Has been used for experimental purposes only, in connection with pneumatic tube system, and is practically good as new. Price for blower and engine complete with bed plate, $500.00. Can also furnish upright boiler of suitable capacity for engine, if desired. Address U. S. Cast Iron Pipe & Foundry Co., Burlington, N. J.

TWO TON "WHITING" IRON JIB crane for sale, mast 14 ft., boom 19 ft., in first class condition. Address Textile Machine Works, Reading, Pa.

NO. 32 HAWLEY DOWN DRAFT OIL furnace for sale, condition guaranteed. Address Box 768. THE FOUNDRY, Cleveland, O.

FOUNDRY EQUIPMENT WANTED.

FIRST CLASS SECOND HAND 3 MOtor electric traveling crane wanted, approximately 17½ ft. span, 3 to 5 ton capacity and 15 ft. lift. State condition, where used and lowest cash price. Address Box 809, THE FOUNDRY, Cleveland, O.

SECOND-HAND FOUNDRY EQUIPMENT wanted, including Cupolas, Ladles, Tumbling Barrels, etc. Quote price and state condition. Address Box 885, THE FOUNDRY, Cleveland, O.

FOR SALE

One No. 5 Blower, built by the P. H. & F. M. Roots Co., Connersville, Ind., capacity of blower 20 cu. ft. per revolution. Adapted to cupola 42 to 54 in. inside lining. At 100 revolutions per minute will melt six tons per hour; at 200 revolutions per minute will melt eight tons per hour; at 250 revolutions per minute will melt ten tons per hour. Price, F. O. B. Chattanooga, $400.00.

One Blower, built by the Connersville Blower Co., Connersville, Ind., rated at 45 cu. ft., suitable for cupolas 54 to 66" inside diameter. At 135 revolutions per minute, will melt twelve tons per hour; at 165 revolutions per minute will melt fifteen tons per hour; at 200 revolutions per minute will melt eighteen tons per hour. This blower is direct connected to a 11 in. x 15 in. horizontal Erie City Iron Works engine. Price, $1,000.00, F. O. B. Chattanooga.

One Ten ton Craig-Ridgway foundry crane	$400.00
One Hydraulic Cylinder 18 ft. x 10 in., price	75.00
One Hydraulic Valve, price	50.00
One Hydraulic Elevator Pump,	250.00
One 72 in.. Whiting Cupola, price.	250.00
Two Berkshire Molding Machines, price, each	250.00

THE CASEY-HEDGES CO.
Chattanooga, Tenn.

720 ENAMELING RECEIPTS

I offer a rare opportunity of obtaining 720 BONA-FIDE ENAMELING RECEIPTS. There are

110 Wrought Iron Slushes.
262 Wrought Iron Enamels.
155 Cast Iron Slushes.
203 Cast Iron Enamels.

They comprise the original private note books of an enameler having 34 years' active experience as a mixer in nearly all the large concerns in the country. The books are veritable mines of information and are interlined with copious notes made shortly after each receipt has been tried out.

Address,

DILLEN UNDERHILL,
Care THE FOUNDRY, Cleveland, O.

SALESMAN WANTED.

EXCEEDINGLY GOOD OPPORTUNITY WITH YOUNG PROGRESSIVE MANUFACTURING CORPORATION FOR BRIGHT, ENERGETIC SELLING GENIUS (CHRISTIAN) BETWEEN 28 AND 35, PREFERABLY WITH FOUNDRY EQUIPMENT EXPERIENCE. RIGHT MAN, AFTER DEMONSTRATED ABILITY AND LOYALTY, WOULD BE ENCOURAGED WITH INTEREST IN BUSINESS AND HAVE MOST FAVORABLE LIFE LONG ASSOCIATION. MUST BE CLEAN CUT, WITH A-1 HABITS AND REFERENCES. GIVE AGE, STATE FULLY PREVIOUS CONNECTIONS, NATIONALITY, SALARY EXPECTED, ETC.

ADDRESS, LIFE CHANCE,
CARE THE FOUNDRY, CLEVELAND, O.

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PAXSON'S QUALITY

MARCH BARGAINS (1910)

We offer the following bargains, subject to prior sale; most of which have been put in first class condition in our shop. Terms Cash. Remember, we buy and sell second hand foundry equipment. (New List each month)

NET PRICE

GREEN BLOWERS (Positive Pressure)

246 1 No. ½, cap. 1½ cu. ft., 6″ outlet. (Cost $150.00) ..... $ 52.50
247 1 No. 1, cap. 3 cu. ft., 7″ outlet. (Cost $225.00) 95.00
254 1 No. 6-B, 45 cu. ft., 25″ side-outlets. (Cost $800.00) 475.00

BAKER BLOWERS (Positive Pressure)

260 2 No. 1, cap. 3½ cu. ft., 6″ outlet. One with blast gate. (Cost $220.00 ea.).....(ea) 85.00
261 1 No. 2, cap. 6 cu. ft., 7½″ outlet. (Cost $270.00) 97.50
263 2 No. 4, cap. 12 cu. ft., 11¾″ outlet. (Cost $425.00 ea.) .....(ea.) 200.00
265 2 No. 5, cap. 25 cu. ft., 15″ outlet. (Cost $500.00 ea.) .....(ea.) 300.00
266 1 No. 5½, cap. 30 cu. ft., 17″ outlet. (Cost $550.00) 350.00
267 1 No. 6, cap. 45 cu. ft., 21″ outlet. (Cost $675.00) 400.00
269 1 No. 7½, cap. 72 cu. ft., 24″ outlet. (Cost $1,175.00) 450.00

ROOT'S BLOWERS (Positive Pressure)

277 1 No. 6, cap. 37 cu. ft., 20″ outlet. (Cost $600.00.) (Wooden impellers)..... 225.00

CONNORSVILLE BLOWERS (Positive Pressure)

282 1—17 cu. ft. cap., 16″ outlet. (Cost $415.00).. 225.00
282-C 1 Cap. 24 cu. ft., 18″ outlet. (Cost $550.00) 375.00
284 1—68 cu. ft. cap., 24″ outlet with 12″ x 12″ vertical engine on same bed-plate. (Cost $2,500.00) 1,250.00

STURTEVANT BLOWERS (Steel Pressure)

293 2 No. 4—7″ outlet. (Cost $50.00 ea.)..... 40.00
294 1 No. 5—8¾″ outlet. (Cost $65.00)..... 52.50
295 1 No. 6—10″ outlet. (Cost $77.00)..... 62.50
296 6 No. 7—12″ outlet. One with up-blast. (Cost $130.00 ea.) .....(ea.) 92.50
296-A 1 Counter-shaft for No. 7 Sturtevant Blower. (Cost $42.50) 25.00
297 1 No. 8—13⅞″ outlet. (Cost $165.00)..... 115.00
298 2 No. 9—16″ outlet. (Cost $227.50 ea.)...(ea.) 117.50
298 1 No. 9—16″ outlet on adjustable bed and C. S. (Cost $450.00) 175.00
298-D 2 15″ diameter Sturtevant blast-gates. (Cost $10.00 ea.) .....(ea.) 7.00

BUFFALO BLOWERS (Steel Pressure)

305-F 1 No. 8—8¾″ outlet and C. S. (Cost $75.00) 43.50
306-F 1 No. 9—10″ outlet on adjustable bed-plate and C. S. (Cost $125.00)..... 95.00
307-K 1 No. 10—12″ outlet with vertical engine 6″ x 5″ on same bed-plate, also C. S. (Cost $475.00) 250.00
309 3 Champion Blowers, 6⅛″ outlet. (Cost $23.00 ea.) .....(ea.) 19.00
311-D 1 6⅛″ Champion Blast Gate. (Cost $2.25).. 1.75

LADLES

333-B 1 1,500 lb. cap. Crane Ladle No. 128. (Cost $23.00) 14.00
334 1 3 000 lb. cap. Geared Crane Ladle. (Cost $62.50) 40.00
338 1 8,000 lb. cap. Geared Crane Ladle. (Cost $120) 90.00

CUPOLAS

344-B 1 Paxson-Colliau Cupola, 54½″ diameter x 40 ft. high. (Cost $365.00)..... 200.00
344-D 1 Colliau Cupola, 63″ diameter and 45 ft. high. (Cost $450 00.) (At Boston, Mass.). 175.00
344-G 2 No. 4 Whiting Cupolas, 56″ diameter.
344-N 1 Newten Cupola, 48″ diameter.
347 3 2-ton Steel Converters and (3) extra bottoms, etc.

BRASS MELTING FURNACES

348-D 1 No. 60 Steele-Harvey (crucible oil melting). (Cost $325.00) 225.00
348-G 1 No. 275 Steele-Harvey (crucible oil melting). (Cost $425) 310.00
348-K 1 Rockwell double chamber furnace No. 2. Cap. 500 lb. per heat, each chamber. (Cost $950.00.) (At Jersey City, N. J.)..... 500.00
350-D 5 Whiting forced draft, 32″ diameter, 38″ deep, for No. 250 pot. (Cost $50.00 ea.) .....(ea.) 25.00

NET PRICE

BRASS MELTING FURNACES (continued)

350-G Statuary Bronze Foundry, near Boston. Complete equipment with (4) 150 pot furnaces, crane, etc. (Cost $800.00) 235.00

CRANES

354 2 5-ton "Box" Traveling Cranes, 220 D. C.—G. E. Motors. Span 30 ft., Hoisting and Bridge Motors 7½ H. P. Racking Motors 4 H. P. (Cost $1,900.00 ea.).....(ea.) 1,100.00
354-B 2 8-ton "Box" Traveling Cranes, same span and motors as above. (Cost $2 100.00 ea) .....(ea.) 1,200.00
356-B 1 5-ton Wooden Jib Crane. Mast 13½ ft., Jig 18½ ft. Lift 11 ft., all complete. (Cost $300.00) 135.00
356-E 1 5-ton Channel Iron Jib Crane (hand power), complete. Mast 24 ft. x 10″, Jib 20 ft., Lift 20 ft. under jib. (Cost $1,000.00). 300.00

TUMBLING BARRELS

358 1 Rumbler C. I. (Cinder Mill 36″ x 48″). Good as new. (Cost $175.00) 125.00
358-B 1 Pair Twin Rumblers, tandem C. I., 24 x 45″ inside T. & L. between. (Cost $250.00 pair) .....(pair) 100.00
359 1 Tumbling Barrel, steel plate, exhaust, never used. 30″ diameter x 48″ long. (Cost $200) 150.00

SEPARATORS

360-F 1 Barnard & Leas Magnetic Separator. (Cost $300.00) 162.50

AIR COMPRESSORS

361 1 16″ x 10″, style "Q" Blake Air Compressor. 350 cu. ft. per M., 20 lb. pres., T. & L. pulley. (Cost $600.00) 350.00
361-A 1 Air Compressor, "Blaisdell," 12″ x 8″, belt driven, cap. 150 cu. ft., 20 to 30 lb. pres., 150 R. P. M., used slightly. (Cost $440.00) 287.50
361-B 1 Air Compressor, "Blake," water-jacketed, 16″ x 10″, belt driven, cap. 350 cu. ft., 20 to 30 lb. pres., 150 R. P. M. (Rebuilt and guaranteed.) (Cost $550.00) 350.00
361-C 1 Air Compressor, "Ingersoll," 10″ x 10″ x 10″, Class F, steam driven, good for 100 lb. air with 100 lb. boiler pressure, cap. 125 cu. ft. air per M., at 150 R. P. M. (Cost $700.00) 450.00

MOLDING MACHINES

363 4 McKenna Molding Machines with Flasks, for Plumbers' Brass Work. (Cost $125.00 ea.) .....(ea.) 65.00
363-D 2 Berkshire Molding Machines (automatic). Floor space 9 ft. 4″ and 6 ft. 5″.
One cost $1,200.00 ..... 550.00
Other cost $1,200.00 (little used)..... 700.00
363-F 12-30″ Adams "Farwell" Squeezers without tool rest, at Newark, N. J. (Cost $45.00 ea.) .....(ea.) 25.00

FLASKS

365 Lot Snap Flasks, Beveled Iron Flasks, Flask Boards, etc.

MISCELLANEOUS

368 3 Hay Rope Twisters, "RIEHLE." (Cost $230.00 ea.) .....(ea.) 120.00
368-A 1 W. & S. Core Machine to make Round Cores ⅜ to 2¼″. (Cost $92.00)..... 50.00
368-K 2 Steel Oil Tanks, 6 ft. x 25 ft. out of ¼″ plates. Cap. 5,000 gallons—dished heads—manhole—inlet and outlet. (Cost $425.00 ea.) .....(ea.) 250.00
368-N 1,000 lbs. 26.76 per cent Ferro-Silicon (lump). (Cost 3c per lb.)..... .02½c
368-P 5 tons Danish Pebbles (assorted) for use in Rumblers and Flint Mills. (Cost $25.00 per ton) .....(per ton) 17.50
368-S 1 Drying Stove, C. I., for Brass Foundry. Good as new. (Cost $25.00)..... 19.00
368-W 1 Adams Milling Head to atta. to planer for hogging. (Cost $250.00)..... 150.00
369 Lot "Harrington" and "Box" chain hoists, 2, 3, 4, 6 and 8-ton cap.

368-X A complete Iron Foundry plant near Lancaster, Pa., 6 tons cap. Buildings, ground, cupola, blower, cranes, rumblers, etc. (Cost new $8,500) present price $5,400.00

J. W. Paxson Co.,
Philadelphia, Pa.,
BALTIMORE, MD. TOLEDO, O.